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HUMAN ENGINEERING LABORATORY HELICOPTER ACQUISITION TEST (HELHAT)

John A. Barnes

Human Engineering Laboratory
Aberdeen Proving Ground, Maryland

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The U. S. Army Human Engineering Laboratory conducted a series of flight tests in 1972 (HELHAT I) and 1973 (HELHAT II) in which the low-level target acquisition performances of combat-trained OH-58 and AH-1 helicopter crewmen were measured. The stationary targets used were both ordnance and high-visibility box-type targets.

This study contains all of the data gathered during these tests and also reports on the 25 performance variables measured for each of the 851 recorded target acquisitions. These variables were used to form the linear equations which were analyzed by the use of a step-wise (continued)

20. Abstract (Continued)

multiple-regression technique in order to identify the variables contributing to stationary target acquisition performance. There were 831 acquisitions recorded during the low-level route reconnaissance flights flown at above the ground levels of 80 to approximately 400 feet and 20 acquisitions recorded during the six nap-of-the-earth 'S' search reconnaissance flights flown at above the ground levels of 1 to approximately 40 feet.

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(HELHAT)

John A. Barnes

September 1974

APPROVED: John D. Weisz
JOHN D. WEISZ
Director
U. S. Army Human Engineering Laboratory

U. S. ARMY HUMAN ENGINEERING LABORATORY
Aberdeen Proving Ground, Maryland

PREFACE

The following report consolidates the information previously published as Technical Memorandum 7-73, "HELHAT I" and Technical Note 1-74, "HELHAT II," into one report which provides an analysis of all of the data obtained from the HELHAT flight tests.

The HELHAT project involved a large number of people and drew data from many sources. The data for the observer's performance at the Naval Weapons Center (NWC) were secured from Human Engineering Laboratory (HEL) films of a portion of the flights, copies of the Coso Range Radar plot sheets and the raw flight-run data provided by the Weapons Development Office, Naval Weapons Center, China Lake, CA, who managed the overall NWC tests. They also furnished the photographs of the NWC targets.

The Aberdeen Proving Ground crew and observer performance data were secured from the HEL films of a portion of the flights, on-board flight observers' logs, voice recordings of the flight communications and radar tracking tapes and plots provided by the U. S. Army Material Testing Directorate Methodology and Instrumentation Division. The targets were emplaced by members of the Recovery and Evacuation Division, Mobility Training Department, U. S. Army Ordnance Center and School. The ordnance targets were furnished the U. S. Army Materiel Systems Analysis Agency. The test range was managed by the U. S. Army Test and Evaluation Command. The overall test was staffed by the Aviation team and other selected members of the Systems Performance and Concept Directorate, U. S. Army Human Engineering Laboratory.

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HELHAT OH 58 with camera configuration.

SECTION I

HUMAN ENGINEERING LABORATORY HELICOPTER ACQUISITION TEST

HELHAT

INTRODUCTION

The HELHAT project was initiated in FY 72. The initial effort was to develop a test plan directed toward the evaluation of the target acquisition performance of our scout and gunship crewmen.

The Phase I test plan was completed and approved in March of 1972. The goal of this phase of the study was to assess differences in target acquisition/detection ability for observers in three distinct aircrew station arrangements: (1) the LOH side-by-side, (2) the COBRA tandem with pilot aft, and (3) the COBRA tandem with pilot forward (Fig. 1).

There was some concern that the pilot/gunner arrangement in AAFSS and COBRA may be reversed from the optimum as far as mission performance was concerned. The basic logic was that in low level and Nap-of-the-Earth (NOE) flight the pilot's principal concern is forward and down, whereas the gunner-observers should be side-scanning. These primary visual tasks are not compatible with either the LOH side-by-side configuration or the COBRA/AAFSS gunner forward tandem configuration.

Phase I of the study left some interesting questions unanswered: does a scout crew detect more targets than a single observer under the same conditions, what is the effect of terrain on low-level target detection and what is the effect of NOE flight on target detection. Phase II of HELHAT was conducted during FY 74 to address these points.

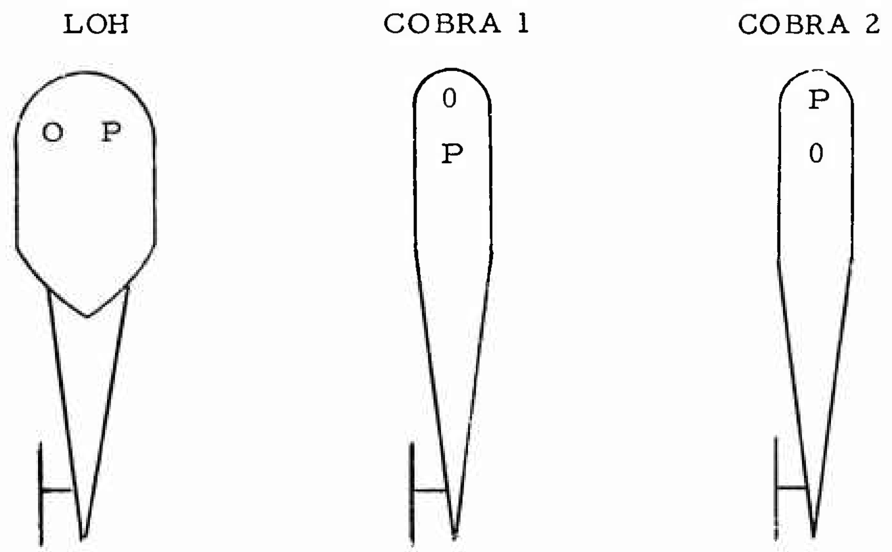
The third phase of the study was designed to make use of all of the target detection/acquisition information acquired in the previous phases. This data was analyzed through the use of a Stepwise Multiple Regression statistical technique in order to determine the significant variables in the air-to-ground acquisition/detection of stationary targets and to assign importance weightings to these variables.

SUMMARY

Phase I of the study showed that the observer on a low-level route reconnaissance mission could function equally as well in either position of a tandem seated helicopter and that his target acquisition/detection performance in the left seat of an OH-58 was better than that in either position of the COBRA, but not significantly better.

Phase II of the study indicated that an OH-58 crew's target acquisition/detection performance was better than that of a single observer, 55 percent of the available briefed targets acquired/detected versus 42 percent when flying the same briefed low-level route reconnaissance mission. The crew's performance on a NOE 'S' pattern reconnaissance of a route produced the same 55 percent acquisition/detection score.

AIRCRAFT



CONFIGURATION

Pilot Right	Observer Front	Pilot Front
Observer Left	Pilot Rear	Observer Rear

P - Pilot

O - Observer

Fig. 1. Experimental configurations.

The altitudes flown on the low-level tests varied from 80 to 400+ feet Above-the-Ground-Level (AGL) while the maximum acquisition/detection ranges varied from 2300M to 280M (Table 11). The NOE missions were flown between 1 and 40 feet AGL and the maximum acquisition/detection ranges varied between 1470M and 370M.

Phase III of the study indicated that the significant contributers to overall low-level target acquisition/detection were:

a. The height of the aircraft above the ground (AGL).
b. The apparent size of the target.
c. The slope/roughness of the terrain.
d. The target's conspicuity within its ground.
e. The distance of the target from the aircraft.
f. The heading of the aircraft.
g. The distance of the target from the flightpath.
h. The sighting angle from the observer to the target.
i. The observer's ability to estimate the target's relative bearing.

When the data was analyzed without considering conspicuity and range and bearing estimation errors, the following variables were added to the preceding list:

a. Target difficulty classification.
b. Relative bearing from the aircraft to the target.
c. Cloud cover.
d. Length of the target.
e. Volume of the target.

The following were deleted:

a. The apparent size of the target.
b. The slope/roughness of the terrain.
c. The observer's ability to estimate the target's relative bearing.

The six NOE flights provided only 20 target acquisitions/detections, therefore the NOE results should be considered as trends. The overall NOE results showed that the following variables entered into the crew's acquisition/detection performance:

a. The apparent size of the target.
b. The distance of the target from the aircraft.
c. The heading of the aircraft.
d. The height of the target.
e. The volume of the target.
f. The visibility conditions.

When the conspicuity and range and bearing estimation errors were not considered the following variables were added:

a. The width of the target.
b. The sighting angle from the observer to the target.

The following were deleted:

a. The aircraft heading.
b. The volume of the target.
c. The visibility conditions.

HELHAT I

Method

One of the primary concerns in developing a means of evaluating these configurations is maintaining simplicity in both approach and instrumentation. For the purposes of this study, the three ingredients of which detection effectiveness is composed are (1) the number of targets detected, (2) the total time consumed on the task, and (3) the total time of exposure of the helicopter to the targets. The purpose of Number 1 is to score target detection. The purpose of Number 2 is to load the crew somewhat in time to avoid maneuvering and speeds which are ill-conceived from a tactically realistic point of view and to work in conjunction with element Number 3, which requires the pilots, necessarily trained and experienced in the scout role, to take maximum advantage of this training and experience in the study.

The flight crews will know that these are the things being measured and they will be competing for a good score. They will not know we are examining the merits of the three configurations in order to eliminate any personal bias they might have. No crew will fly more than one of these configurations and a time spread will be built in between testing of each configuration to insure isolation among these elements.

No attempt will be made to use military targets. The nature of targets planned is such as to eliminate any requirements for sensing or discriminating any target stimuli at or near threshold values. This test is not for aircrew vision as such, it is to seek out the magnitude and direction of differences in detection that are or may be associated with overall cockpit configuration/crew arrangement. Our basic hypothesis is that Pilot Front-Observer Rear will surpass both Observer Front-Pilot Rear and Side by Side by nature of its proper division of primary visual areas of concern.

The six targets (Fig. 2) that will be used can be clearly identified by symbols rather than alphanumerics.

These targets will be executed in high visibility colors, black on yellow, and will measure 4 x 8 feet. They will be set along a course utilizing the Aberdeen Proving Ground (APG) test area. The flight plan will be a route reconnaissance closely following test roads and taking advantage of the terrain in that area. Only one target will be capable of being seen at a time. Flight time over the course will be 20 minutes. When either of the flight crew spots a target, he will immediately press the detection response button and announce the target symbol over the radio.

The aircraft will be equipped with three 16mm motion picture cameras which will provide a complete record of the aircraft's flight path during the run. An event marker light will go on when the crew depresses the detection response button and will stay on some two seconds. The appearance of this light on the tracking film is the fiducia for the point of detection, the exposure time is derived from a simple frame count of the tracking film. Many elaborations are possible but the three essential measures — (1) total time, (2) exposure and (3) number of detections — can be derived from the data yielded by this scheme.

There will also be a synchronizing light mark provided on the film at random times so that the film from the three cameras output can be viewed in proper alignment.

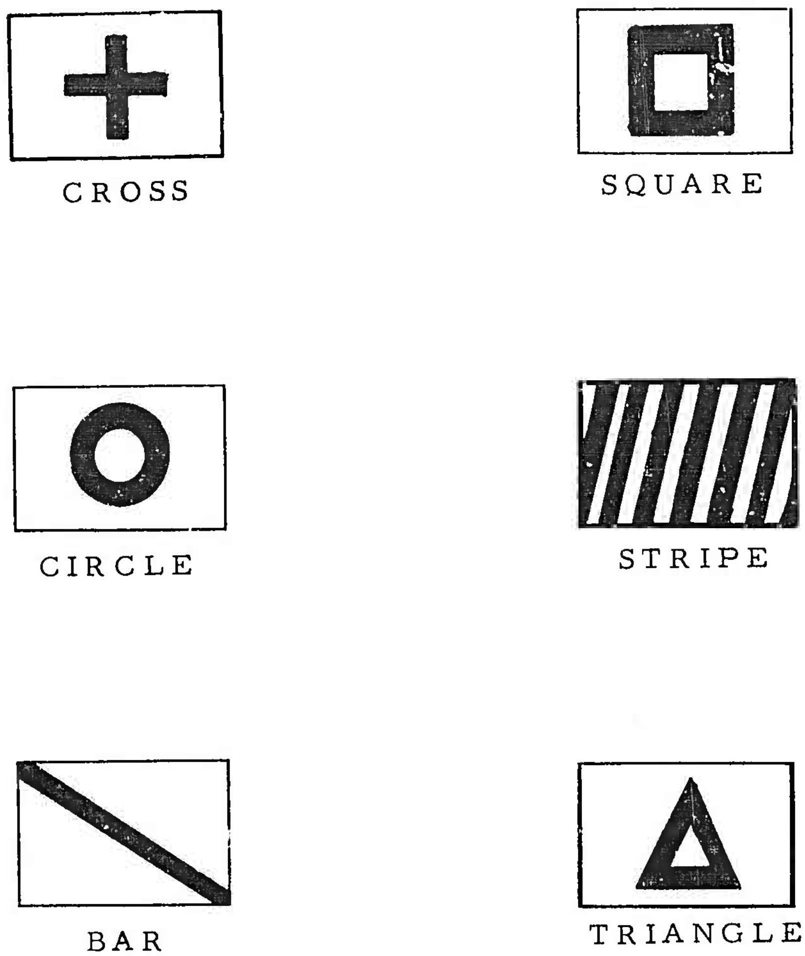


Fig. 2. HELHAT targets.

The essential points of HELHAT I are:

1. The importance of crew arrangement, its interactions with vision areas, hence the mission.

2. The importance of crew arrangement as it affects the basic configuration of the aircraft.

3. The importance of target detection on overall play of the engagement sequence.

HELHAT I will be sensitive to seasonal weather conditions and therefore the work flow as shown on the Schedule of Events (Fig. 3) is critical.

The experiment is designed to take full advantage of the Target Detection/Identification Model Calculations developed by Franklin and Whittenburg.[1] Eight input variables are given for this model:

1. Target size.

2. Target shape.

3. Target/ground brightness contrast.

4. Clutter.

5. Slant range.

6. Aircraft altitude.

7. Aircraft speed.

8. Terrain type.

HELHAT I will keep Variables 1, 2, 6, 7 and 8 constant and will attempt, by proper course design, to keep Variables 3 and 4 constant. This plan will enable us to use the slant range at which the targets were detected as one of the scoring measures. The other scoring measure will be the value in seconds of S_s - S_c where S_s is the time the crew reported seeing the target and S_c is the time the target was available for sighting.

The three aircraft mounted cameras will provide a continuous film record of each flight and will enable the Data Reduction Team to determine when the target first was available for sighting, the actual time and position when the target was sighted, and the aircraft's path over the test area.

The targets in the test area will be set such that two targets will be to the left of the desired flight path, two will be to the right, and two wi l be on the flight path.

Franklin and Whittenburg[1] provide a detailed description of test model and the calculations involved.

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[1]Franklin, M. E., & Whittenburg, J. A. Research on visual target detection, Part I, development of an air-to-ground detection/identification model. Human Sciences Research, Inc. McLean, Va., 1965.

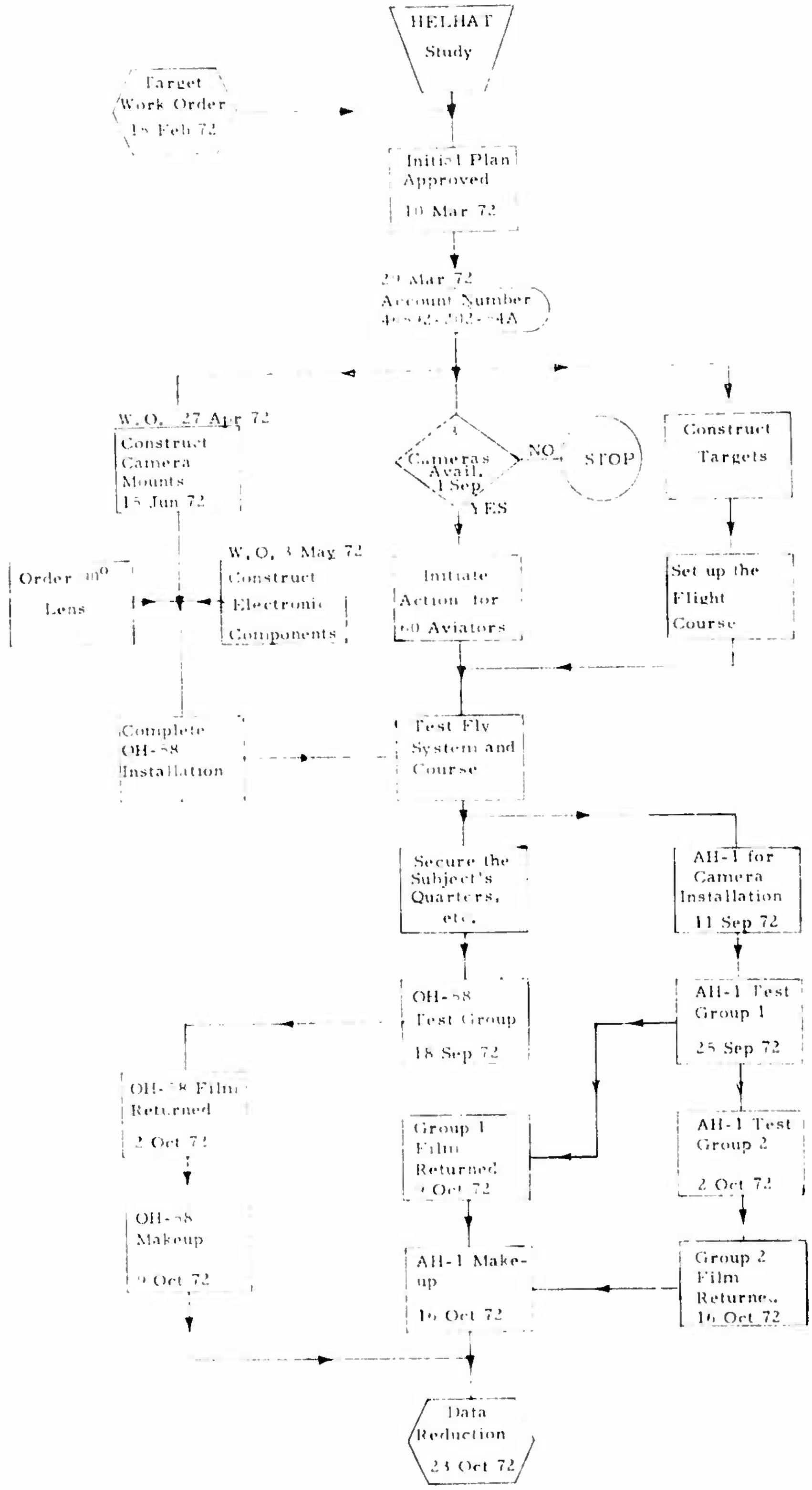

Fig. 3. Schedule of events.

The use of 10 crews for each test conditions is dictated by the calculation for the minimum value for n where a normal distribution is assumed. This is given as $N(1-x) = 5$, thus, for a normal distribution where $x = .5$, we have:

$$n(1 - .5) = 5$$
$$.5n = 5$$
$$n = 10 \text{ the minimum value.}$$

The experiment is made up of three conditions:

1. Pilot right side, observer left side.

2. Pilot aft, observer forward.

3. Pilot forward, observer aft.

There are six equal sized targets and 10 different crews' trials on each target under each condition.

This design will allow several types of statistical analyses to be performed on the data, ranging from simple mean values through analysis of variance.

Phillips Army Airfield is in a good position to support the HELHAT tests. Preliminary planning as regards the setup of flight routes (Fig. 4) and target locations has been initiated. Detailed planning of scout scenarios will include support of combat-experienced scout aviators to account for some of the techniques of this highly-specialized kind of flying. If flights and target arrangements are not carefully worked out, a great deal of data could be lost because of lack of intervisibility. It is important to consider the requirements for the future HELHAT studies and to plan target areas that will allow free-fire gunnery and permanent target locations for the follow-on work.

The test will require a minimum of two aircraft. One will be an LOH, either an OH-6 or OH-58, and the other will be an AH-1. The AMC Aviation Office does not foresee any difficulty in providing a COBRA during August, September and October, although they are in short supply. The side-by-side aircraft can be provided by Phillips Army Airfield in the form of one of their OH-58As. The aircraft will be flown for one hour by each subject crew, therefore the LOH (OH-58) will be flown for 10 hours and the AH-1 will be flown 20 hours. There will also be a requirement for an aircraft to fly the pilot study when the course is set up. It appears that a planning allowance of 10 flight hours should be ample for these tasks. The total flight hours required are 40: 20 hours in the AH-1, 10 in the OH-58 and the remaining 10 probably also in the OH-58.

The study will require the airborne cameras to have a low frame rate 20 minute run-time and be of minimum weight. The present "on hand" cameras do not possess this capability. The DBM-4C versions of the Milliken can be fitted with standard Milliken motors which allow frame rates of 4, 5, 8 and 12 frames per second with no ancillary equipment, such as pulsing devices, etc., needed. The cost of these motors is approximately $300 per unit and they are a standard, off-the-shelf item which adds no extra weight to the camera. These motors will provide the desired film run-time, no complicated setting procedure, and they are not sensitive to voltage fluctuation as are the infinite speed adjust cameras. The study, as now planned, will use three such cameras on the aircraft.

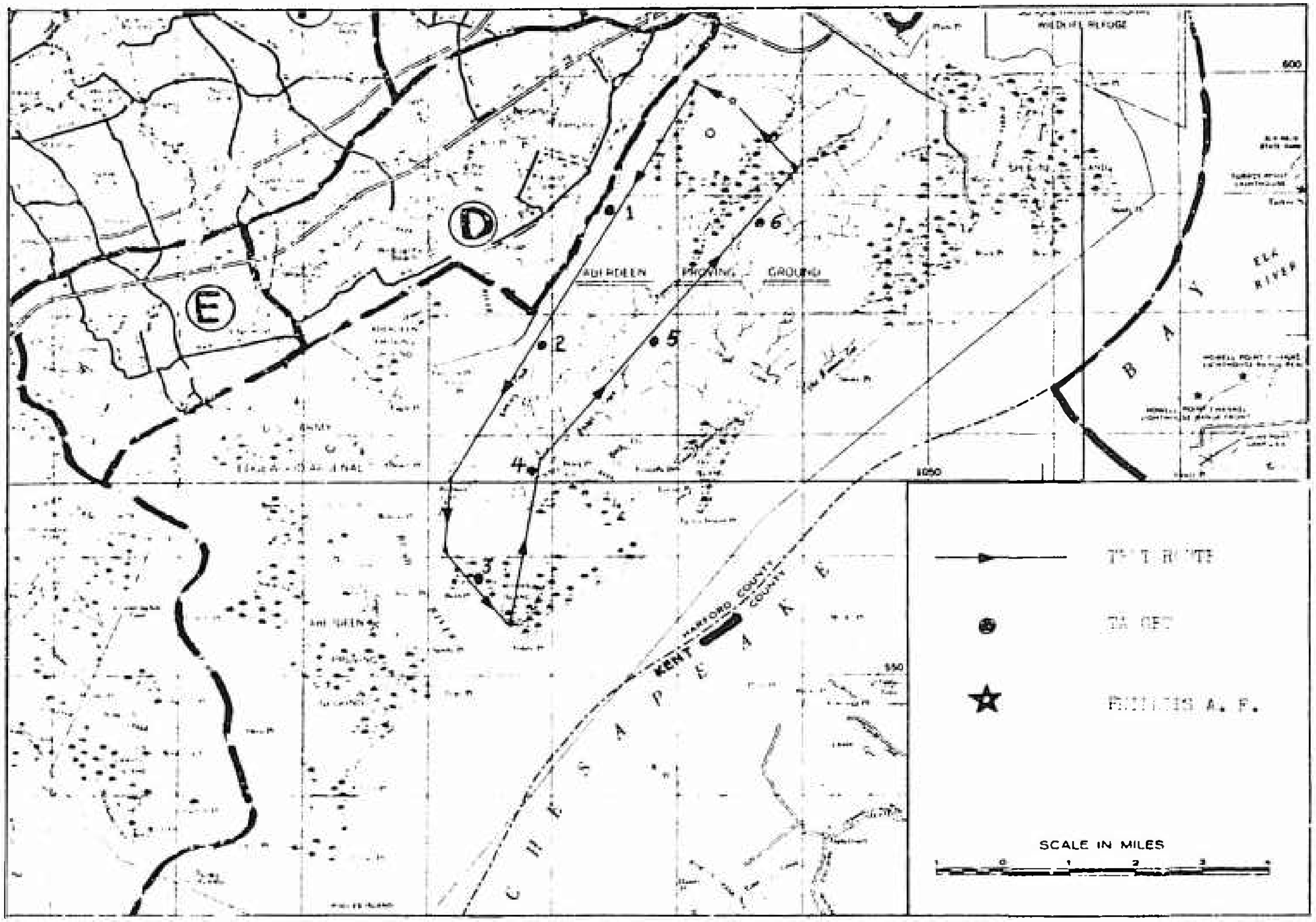

Fig. 4. HELHAT flight route and target positions.

The Aviation Team has two members assigned full time to this project to design the test plan and to conduct the test. In addition, this test will require 10 combat-ready OH-58 scout pilots, 10 combat-ready scout observers, 10 combat-ready AH-1 pilots, 10 combat-ready front seat qualified/experienced AH-1 pilots and 20 combat-ready AH-1 scout observer/pilots. These 60 airmen are required in order to perform the 10 test runs in each of the three crew configurations being compared. There are no pilots available at Aberdeen Proving Ground who qualify as subject pilots or observers.

The targets to be used have been designed for the late summer season when the trees and bushes are in full leaf and the weather is fairly stable. This allows the period of 1 May through 20 October to set up the course, run the pilot experiment, and complete data collection. To meet this schedule (Table 1), it is imperative that the study have sufficient priority to allow completion of all work orders submitted in accordance with the Schedule of Events.

TABLE 1

Experiment Schedule

Month	Event
March - April	Develop detailed flight scenarios utilizing CPT Furman and others. Fly the various areas and routes to select target position and approach options.
May – June	Visit CDEC, TRICAP and other field testing centers to discuss scenario development, long range test integration requirements, future utilization of VIPOR and various sources of subjects. Write up results and findings.
July	Test setup and installation.
August – September	Run HELHAT Phase I and modify camera mounts for AH-1.
October	Allow for weather and slippage (built in hold).
November, December, January	Analyze data and report findings.

All crews will be given a map briefing that will contain the following situation:

Intelligence reports that the enemy is prepared to cross Bush River momentarily in an effort to capture this airfield. The enemy may have already covertly crossed the river and emplaced several of their new PM weapons along the shoreline between Pond Point and Abbey Point and along the two roads leading to the airfield. The commander wants an immediate route reconnaissance made of the roads and shoreline so that any of these weapons found can be destroyed within the next 30 minutes. The enemy has radar controlled guns along the south shore of Bush River so your flight altitude will have to be below 100 feet. Previous flights in the area report wires and obstructions to a height of 50 feet so this is your safe minimum altitude. It is necessarily to have your report within the next 30 minutes.

The crew will then go to the aircraft, start up, and fly the mission. They will have approximately 20 minutes left in which to complete the flight in order to meet the 30 minute time allowed.

The targets each have an area of 32 square feet and a volume of 32 cubic feet; therefore, careful consideration has to be given to the placement of these targets. Previous work in target identification from low flying aircraft has provided us with the square mil-formulation which provides a mathematical method to determine the angle at which the targets should be elevated to provide equal size presentations to the flight crews at any orthogonal position and slant range. The six targets will be spaced along the course so that the mean time between targets will be 150 seconds. They will be painted a fluorescent yellow with a black identifying figure. The targets will be set in the wooded areas in such a manner that they will be visible during the aircraft's approach, but cannot be seen once the aircraft has passed a given bearing.

The funding requirements are as follows:

Aircraft utilization (PAAF) (operation, service and maintenance)	$18,000
Subjects (travel and per diem) ($5,000 more if billeted off-post)	10,620
Slow speed motors for Milliken cameras	900
Targets and racks	500
16mm film and processing	1,200
Preliminary flight work and pilot study – to PAAF	5,000
Airborne event recorder	GFE
Target placement	GFE
	$35,220

Shortly after this plan was approved, it was learned that the U. S. Army Materiel Systems Analysis Agency (AMSAA) was participating in a joint services helicopter armament evaluation test scheduled to be held at the Naval Weapons Center (NWC), China Lake, CA, during the early fall of 1972. Further investigation revealed that it would be possible to achieve the major objectives of the Phase I test plan by participating in this test and by providing the additional funding necessary for the use of facilities peculiar to the HELHAT project.

This study, the first in a series addressing the problem of air/ground target acquisition, deals with stationary target detection as it is affected by the observer's position in the aircraft. There is some concern that the pilot/gunner arrangement in tandem seat helicopters such as the AH-1G may be reversed from the optimum as far as mission performance is concerned. The basic logic is that in low level flight the pilot's principal concern is forward and downward, whereas the gunner/observers should be side-scanning. These primary visual tasks do not appear to be compatible with either the OH-58 side-by-side configuration or the AH-1G gunner forward tandem configuration.

Flight tests to examine these relationships were flown at the Coso Military Target Range of the Naval Weapons Center, China Lake, CA, utilizing the OH-58 Kiowa and the AH-1G Cobra flown by combat ready crews. The targets were military ordnance items of the 1950-1960 era. The flights were scheduled to be flown at altitudes of 100 feet or less but the radars were unable to track the aircraft at these lower altitudes because of the rough terrain; therefore, a base altitude of 100 feet was established and the flight legs were flown at altitudes from 100 feet to a maximum of 200 feet. The higher altitude gives the observer some advantage on certain targets, but when all of the scores are pooled this slight advantage appears to be absorbed.

The targets reported by each observer on each flight were analyzed to determine if the observer's position in the aircraft made any significant difference in the number of targets he reported. The observer positions were shown in Figure 1. Each observer made two flights with the position and flight sequence determined by the experimental plan. This analysis indicated that there was no significant difference in the overall number of targets located that could be attributed to the aircraft. The statistical tests showed a significant relationship between the targets reported and the first and second run for the observer which indicated that the second flight, regardless of the position of the observer in the aricraft, should have produced a higher number of targets detected.

Of primary concern was the developing of a means to evaluate the observer's positions and maintaining simplicity in both approach and instrumentation. The experiment was designed to measure three elements of target detection:

1. Number of targets detected.

2. Total time consumed on the task.

3. Total time the helicopter was exposed to the target.

This report is concerned with the first of these elements.

The targets used were actual military ordnance of the 1950-1960 period, but the observers were not required to correctly identify the targets by official nomenclature; rather, they reported the clock position relative to their aircraft heading, a generic name for the target, and the estimated range in meters. The majority of the targets were painted in standard military camouflage greens and browns and showed a considerable amount of rust. Figures 1A through 21A show some of the targets seen by the observers while flying the designated legs.

The 34 subjects who flew in these tests were all U. S. Army pilots. They were from the 1st Squadron, 9th Cavalry, 7th Squadron, 17th Cavalry, 1st Cavalry Division, Fort Hood TX, and from the 101st and 158th Aviation Battalions, Fort Campbell, KY.

At each target report, a mark was made on the radar plot of the flight and a voice recording was made so that the experimenter had a written and a recorded description of each sighting by each observer. The actual targets to be scored were unknown to the observers so they were instructed to report all items of interest along their flight path as they would during an actual "Route Reconnaissance" type mission. This method also gave the measure of "clutter" for each observer as there was a considerable amount of ordnance debris along the flight course. Clutter was the total number of reported targets on a leg versus the number of scored targets reported on that leg. The targets used for scoring are described in Table 2. The target numbers listed are the numbers assigned to these targets by the Naval Weapons Center for the Coso Military Target Range.

TABLE 2

List of Targets

Target Number	Type of Target	Heading	Latitude	Longitude	Elevation	Length	Width	Height	Number of Items
1	M-48 Tank	281°[a]	36°10'40"	117°47'12"	6716	24' 5"	12'	9' 10"	1
2	105MM Howitzer	261°	36°11'36"	117°46'35"	6843	19' 8"	7' 1"	5' 2"	3
3	M-211 Truck	156°	36°11'33"	117°45'21"	6970	22' 5"	8'	9' 4"	3
4	M-535 Shop Van	348°	36°11'12"	117°46'20"	6853	21' 4"	8'	9' 10"	c
5	90MM Gun-Mount	043°	36°10'55"	117°46'21"	6974	20' 10"	8' 5"	9' 4"	1
6	M-4 Tractor	186°	36°11'05"	117°46'09"	6866	17' 6"	8' 1"	9'	1
7	Bridge; 1 Lane	071°	36°10'54"	117°45'45"	6902	170'	16'	8'	1
8	Truck, Amphibious	211°	36°10'46"	117°45'19"	6900	31'	8' 3"	8' 10"	1
9	Trailer, Radar V-62	021°	36°11'06"	117°45'02"	6952	20' 2"	8' 2"	10' 5"	1
10	Trailer, Radar V-62	206°	36°10'58"	117°45'05"	6930	20' 2"	8' 2"	10' 5"	1
11	75MM Sky Sweep Gun	061°	36°11'29"	117°43'59"	7543	25' 5"	8' 6"	9'	3
12	Search Light	046°	36°11'59"	117°43'25"	7681	7' 10"	5'	7' 10"	3
13	Jeep; 1/4 T, 4 X 4	146°	36°11'45"	117°43'39"	7657	11' 7"	5' 1"	3'	2
14	75MM Sky Sweep Gun	271°	36°11'45"	117°43'37"	7658	25' 5"	8' 6"	9'	1
15	M-47 Tank	006°[a]	36°11'40"	117°43'30"	7624	23'	11' 7"	9' 10"	1
16	Trailer, Radar V-62[b]	126°	36°11'28"	117°43'46"	7591	20' 2"	8' 2"	17' 8"	1
17	Truck, Amphibious	196°	36°11'18"	117°43'40"	7536	31'	8' 3"	8' 10"	2
19	M-37 Truck	006°	36°11'36"	117°43'45"	7592	15' 4.75"	6' 1.5"	6' 1.5"	3
22	Supply Dump	066°	36°12'03"	117°43'38"	7704	---	---	---	d
23	Bridge; 2 Lane	081°	36°11'40"	117°43'20"	7592	228'	26'	25'[e]	1
24	Bridge; 1 Lane	121°	36°11'06"	117°46'42"	6850	160'	16'	40'[e]	1
26	Truck, Pickup (Chev)	261°	36°11'36"	117°46'37"	6834	16' 7"	6' 6"	6' 2"	1
27	Tractor and Tanker	226°	36°11'37"	117°43'46"	7592	42'	8' 2"	9' 1"	1

[a] Heading given is that of the gun in "Traveling Position".

[b] This radar van has a dish antenna; '2" L, 3'W, 7'3" H.

[c] There is also a T-33 fuselage and wing setting next to the van.

[d] This contains a M-211 Truck, 2 ea 8'x8'x10' huts, 2 ea 90MM guns, and numerous boxes. The heading given is that of the truck and is the general direction of the Supply Dump.

[e] This is height of bridge floor above terrain.

Every observer flew two flights. On each flight he was seated in a different position in the aircraft and flew the course in a different direction than that of his first flight. There were 34 observer subjects and a total of 68 flights were flown. The planned flight order was as follows:

1. Flight one, front seat of AH-1G; flight two, rear seat.

2. Flight one, rear seat of AH-1G; flight two, front seat.

3. Flight one, left seat of OH-58; flight two, rear seat of AH-1G.

4. Flight one, left seat of OH-58; flight two, front seat of AH-1G.

5. Flight one, front seat of AH-1G, flight two, left seat of OH-58.

6. Flight one, rear seat of AH-1G; flight two, left seat of OH-58.

It was planned to have six observers tested under each of these conditions. In all cases, the first flights were made with the initial leg heading of 045° and the second flight was made with an initial leg heading of 225°.

The flight course consisted of three legs approximately three miles each in length with 045°/225° tracks. The terrain is very rugged (Fig. 5), with rapid changes in elevation. The course was to be flown at a height above the surface of 100 feet and a speed of 60 knots. The roughness of the terrain and the necessity of maintaining radar contact caused some variation in the altitudes and speeds actually flown.

The experiment was designed to take full advantage of the Target Detection/Identification Model Calculations developed for the Human Engineering Laboratory by Franklin and Whittenburg.[1] Eight input variables were given for this model as:

1. Target size.

2. Target shape.

3. Target/ground brightness contrast.

4. Clutter.

5. Slant range.

6. Aircraft altitude.

7. Aircraft speed.

8. Terrain.

The data on these input variables and other will be given in a follow-on report in which the actual flight data will be used to determine the significant variables affecting the acquisition/detection of stationary targets from low flying helicopters.

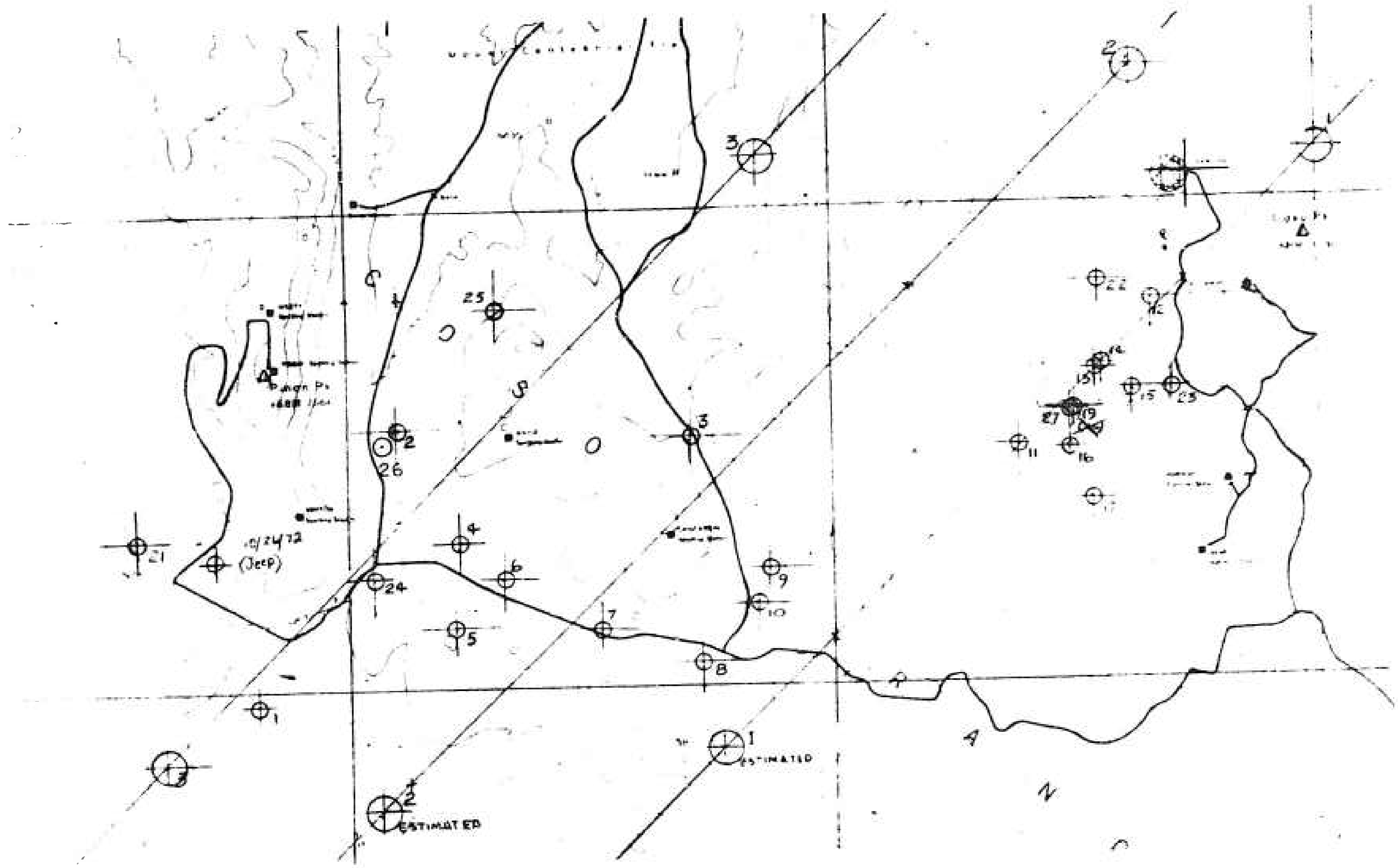

Fig. 5. HELHAT I flight test area with annotated targets.

It was planned to have six observers in each of the six flight order cells. Unfortunately, two of the test observers did not arrive in time for the flights due to an aircraft malfunction enroute and a misunderstanding of the flight schedule caused one cell to have seven observers. The actual experiment was as shown in Table 3.

TABLE 3

Experimental Order

Flight Order	Number or Subjects
1	6
2	6
3	5
4	5
5	7
6	5

Results

The data from the flight tests were analyzed for two distinct conditions of target acquisition. The first analysis used all of the actual targets that were reported by the subject as the score for the run. The second used only those targets which were reported when within $\pm 080^{\circ}$ of the aircraft's heading and at a range of 100 meters or greater. The first condition would be valid for a route reconnaissance and the second for a seek and destroy mission. The actual scores of each observer for each of these conditions is given in Section II.

There were three data cells with only five scores, one with seven scores and two with the planned six scores. A preliminary analysis of the data indicated that the scores of the extra flight in Order 5 could be moved to Order 6 without changing the overall statistical value of these orders in the total analysis. The two cells, one from Order 3 and one from Order 4, were filled in using missing data techniques as Outlined by Winer.[2] With the experiment now in a factorial 6 x 6 format, an analysis of variance was performed using the form given as a Model II in Hayes.[3] The results are shown in Table 4.

TABLE 4

Analysis of Variance

Source	SS	df	MS	E	F
Order	26.7361	5	5.3472	5.461	.2791
Columns	97.5690	5	19.5138	5.819	1.0187
Interaction	478.8477	25	19.1539	5.461	3.7783
Error	182.5000	36	5.069	5.069	
Totals	785.6528	71			

[2]Winer, B. J. Statiscal principles in experimental design. New York: McGraw-Hill, 1971.

[3]Hayes, W. L. Statistics for psychologists. New York: Holt, Rinehart & Winston, 1963.

The F value for the interaction term, significant at the .01 level, indicates that there is an observer-position/order of testing relationship which could be a learning effect for the second run. In order to investigate this possibility further, tests of the difference between means for the various testing conditions were conducted with the results shown in Table 5.

TABLE 5

Difference Between Means

Condition	Sigma	SD_d	t	$\overline{X}_1$	$\overline{X}_2$	Run
Front/Rear	3.7	1.4965	.334	18.6	19.1	1
Front/Left	2.99	1.22	1.56	18.6	20.5	1
Left/Rear	2.98	1.22	1.15	20.5	19.1	1
Front/Rear	2.36	.9636	.31	20.8	20.5	2
Front/Left	3.07	1.2528	1.916	20.8	23.2	2
Left/Rear	3.27	1.3328	2.026	23.2	20.5	2
Front	2.49	1.2199	1.803	18.6	20.8	1/2
Left	3.11	1.2688	2.128	20.5	23.2	1/2
Rear	3.18	1.2961	1.08	19.1	20.5	1/2

The only relationship that was significant in Table 5 was that between the first and second runs in the left seat of the OH-58; this relationship was significant at the .05 level

There also appears to be some relationship at a lesser level of confidence between the OH-58 position and the front and rear seat of the AH-1G, and it is quite obvious that the observer's position in the AH-1G does not affect his performance in that aircraft. In general, the observers in the OH-58 scored higher than those in the AH-1G when flying similar routes.

The data above have been for all targets reported, regardless of their relative bearing and distance from the aircraft when reported. When the data were analyzed with the restriction that only targets within ±080° of the aricraft heading and at a range of 100 meters or greater would be considered, the analysis of variance results were as shown in Table 6.

TABLE 6

Analysis of Variance – Restricted Scores

Source	SS	df	MS	E	F
Order	17.57	5	3.51	8.33	.35
Columns	20.57	5	4.11	3.33	.41
Interaction	312.35	25	12.49	8.33	1.52
Error	295.50	36	8.21	8.21	
Total	645.99	71	Pooled MS Error = 9.96		

There was no F value that was significant under these conditions. When the difference between the means was investigated several significant relationships appeared. Table 7 shows these relationships.

TABLE 7

Difference Between Means – Restricted Scores

Condition	Sigma	SD_d	t	$\overline{X}_1$	$\overline{X}_2$	Run
Front/Rear	2.41	.9843	0	15.0	15.0	1
Front/Left	1.99	.8111	2.979	15.0	17.4	1
Left/Rear	2.08	.8476	2.851	17.4	15.0	1
Front/Rear	2.91	1.1884	.981	19.1	17.9	2
Front/Left	3.60	1.4696	.737	19.1	20.1	2
Left/Rear	2.91	1.1884	.210	20.2	17.9	2
Front	2.94	1.1982	3.408	15.0	19.1	1/2
Left	2.88	1.1756	2.339	17.4	20.1	1/2
Rear	2.38	.9724	2.999	15.0	17.9	1/2

For the first run condition, the scores obtained by the observers flying in the left seat of the OH-58 were significantly different at the .01 level, from the scores obtained by the observers flying either seat of the AH-1G. The scores for the first and second runs in either seat of the AH-1G were significantly different at the .01 level, while those for the OH-58 were significantly different at the .05 level.

Discussion

The results of this part of the experiment appear to provide a very definite answer about the observer's reconnaissance performance in a tandem seated helicopter: the observer can function equally well in either position so in future applications of this seating arrangement to combat type helicopters, the prime consideration should be the seating of the pilot in the position that is the most advantageous to him for the designed task of the aircraft.

The left seat poistion of the observer in the OH-58 seemed to be superior in all cases to either of the tandem positions; the difference was not significant for overall reconnaissance work but it was significant when the $\pm 080^{\circ}$/100 meter restriction was applied to the sightings. When the remaining data are analyzed to produce the predictor equation, it is felt that a definite reason for this apparent advantage will emerge. This test was conducted in terrain that made both flying and target detection quite difficult, so the results can be considered to be very conservative. An additional difficulty was the amount of ordnance debris along the test course. The range is used for gunnery as well as target detection, with the result that the debris ranges from spent cartridges to crashed aircraft and parts thereof. The mean clutter factor was 26 percent ± 2 percent for all the observer positions (Clutter Factor = 100 Percent – Actual Targets/Sightings) which indicates that all positions and all flights were affected about the same by the range debris.

HELHAT II

The three HELHAT II target detection flight tests were flown at Aberdeen Proving Ground, MD, during July and August 1973. The purpose of these tests was to determine: (1) the low-altitude target detection ability of a two-man scout helicopter crew, (2) that of a single observer being flown in a scout helicopter by a nonparticipating pilot, and (3) the Nap-of-the-Earth target detection ability of a two-man scout helicopter crew when the aircraft was flown at altitudes ranging from 1 foot to 40 feet, depending upon the ground cover.

Method

The OH-58 Kiowa helicopter was used in these tests since it had been determined in the October 1972 test program that there was no significant difference in target detection performance of observers tested in the left seat of the OH-58 and in either seat of the AH-1G Cobra helicopter.

A flight course (Fig. 6) was set up at Aberdeen Proving Ground which was approximately 14 miles in total length and divided into two 6½-mile legs with a 1 mile crossleg. There were 15 targets placed along the course. These targets were placed in positions determined by the study of inflight films of the course. All of the positions were in open areas and their "off course" distances from the briefed flight track ranged from 100 to 2400 meters (Table 8). Targets number 2, 4, 7, 10, 12 and 15 were Day-Glo orange box targets; targets number 1, 3 and 5 were radar vans; targets 8, 9 and 11 were missile launching trucks; targets number 13 and 14 were rocket launchers; and target number 6 was a jeep with a enclosed passenger area. The "crew" flight test portion of the study had an additional four targets (5 feet x 5 feet "sail") placed such that there were two along each of the 6½-mile legs. These "sail" targets were part of another study which was concerned with performance differences in day operations and vision-aided night operations.

Off-Course Distance

Target Number	Type of Target	Off-Course Distance (Meters)
1	M-258 Van	270 Left
2	Day-Glo Orange Box	370 Left
3	M-259 Van w Antenna	460 Left
4	Day-Glo Orange Box	330 Left
5	V-62 Van w Antenna	220 Right
6	M-38 Jeep w Hard Top	100 Left
7	Day-Glo Orange Box	1000 Right
8	XM387E1 Missile Truck	2390 Right
9	XM387E1 Missile Truck	1280 Right
10	Day-Glo Orange Box	130 Left
11	XM387E1 Missile Truck	550 Right
12	Day-Glo Orange Box	180 Right
13	M-21 Rocket Launcher	770 Left
14	M-21 Rocket Launcher	290 Left
15	Day-Glo Orange Box	160 Right

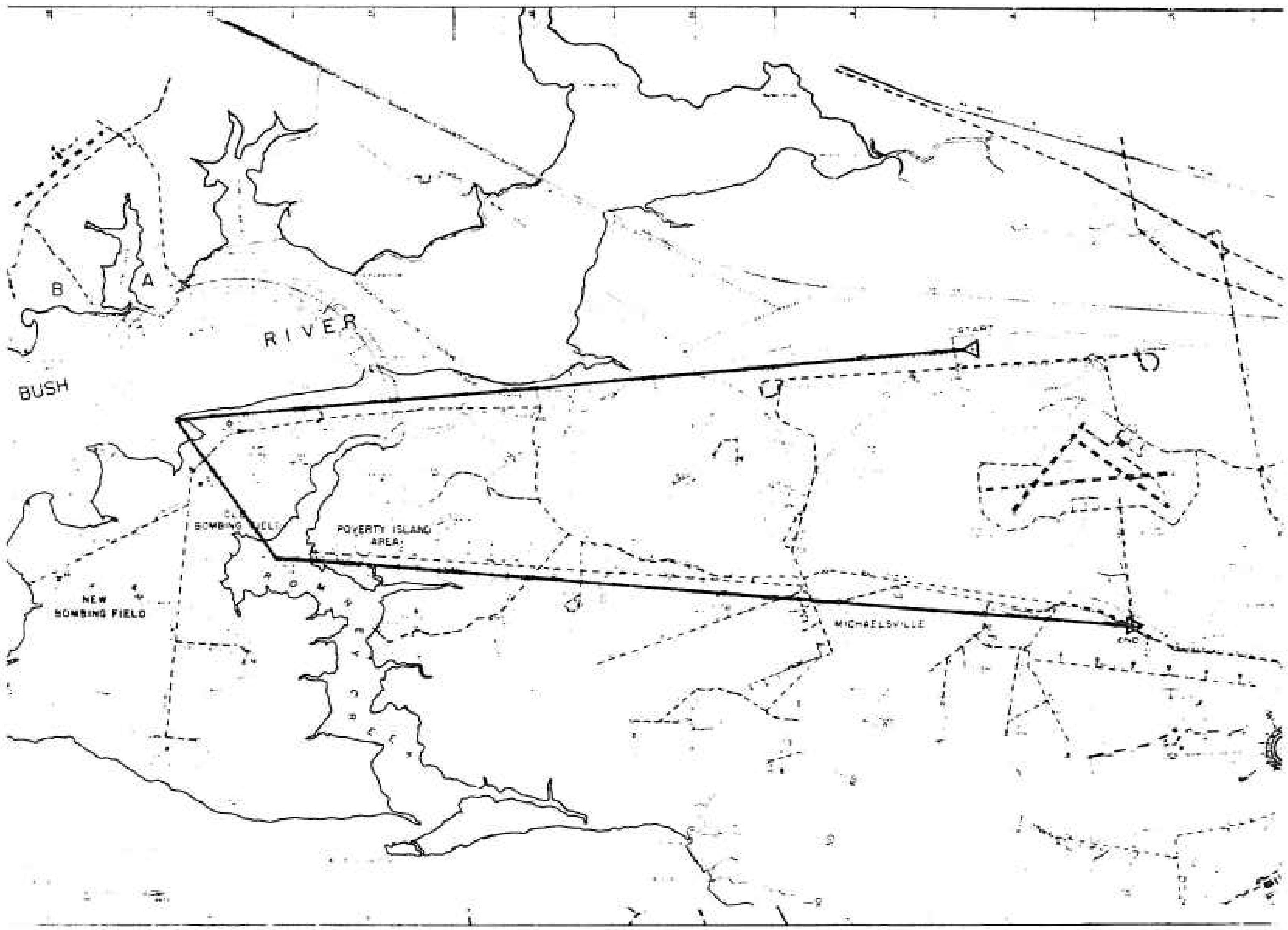

Fig. 6. HELHAT II flight course and annotated targets.

The high visibility Day-Glo orange targets provided a type of control target. The original test plan called for this type of target exclusively as it would essentially eliminate the identification problem associated with ordnance targets, but it was not possible to use them at the Naval Weapons Center. They were added to this test to determine the effect of a high visibility item on target detection performance.

The 36 subjects who flew in these tests were all U. S. Army pilots: 35 of them were from the 1st Cavalry Division, Fort Hood, TX (20 from the 1st Squadron, 9th Cavalry and 15 from the 7th Squadron, 17th Cavalry) and one was from Phillips Army Airfield, Aberdeen Proving Ground. All of the subjects were considered to be combat qualified and the majority of them were Southeast Asia (SEA) returnees.

The crew test utilized 24 pilots from Fort Hood. The 12 two-man scout crews were made up so that at least one crew member was a SEA returnee. All of the pilots in the observer tests were SEA returnees. The NOE test used 12 pilots who were SEA returnees and who had flown either in the crew tests or the observer tests prior to the NOE flights.

Fifteen of the subjects from Fort Hood had flown in the October 1972 test program at NWC. Ten of these fifteen subjects had flown in either Flight Condition 3 or 4 of the NWC Program. These conditions were such that the pilots' first flight of the test was flown as an observer in the left seat of the OH-58. The NWC tests were operated under essentially the same experimental conditions as these tests. Therefore, we were able to include the target detection performances of these 10 subjects in this study.

All subjects were given the following recorded briefing:

Intelligence reports that the enemy has crossed the Bush River in a covert effort to capture this airfield. It is believed that the enemy has emplaced several truck mounted surface-to-surface missile launchers, carriage mounted multiple rocket launchers and possibly some radar and radio-control vehicles. They also may have several of their new missile guidance sensors in the area. These are housed in bright box-like covers and should be easily seen. In order to allow the enemy to believe that his action has not been detected, business in the affected area is going on as usual but the base commander wants an immediate route reconnaissance made of the roads and shoreline so that any of these weapons found can be destroyed. You will fly the altitudes shown in your flimsy and report by radio the range in meters and the clock position of any possible enemy positions. Do not wait until you see their "Yellow Ball" insignia before you report a suspected position, report first and identify later if possible, by use of the word "Confirm" and the target name. We also may have some special detectors in the field which are "sail like" in appearance with an area of approximately 25 square feet. If any of these are seen, please report their range and clock position.

The reference to the "sail like" special detectors was deleted from the briefing to the single observer group and the NOE group. Following the recorded briefing, a film of the course which was made prior to the placement of the targets, was shown to the subjects. After this initial briefing, all subjects were told that they could listen to the tape and look at the film as much as they desired. In addition, a printed copy of the briefing was posted in the ready room. Each man was given a flimsy which gave him the magnetic heading of each leg of the course and the start and end points of the test course.

The flight periods were planned so that there would be a minimum amount of shadow from the targets and their surroundings. The flight periods began at 1030 hours and ended at 1330 hours, with the first takeoff at 1130 hours and the last landing at 1305 hours of each test day. The average time for a flight test was 15 minutes out of the total flight time of 20 minutes. The photometric flight was a special daily flight to allow the experimenter to take light measures of the targets, their foregrounds, and backgrounds for use in contrast calculations for HELHAT III (Table 9).

TABLE 9

Daily Flight Schedule

Flight	TO	LDG	TO	LDG	TO	LDG	TO	LDG	TO	LDG
1	1130	1150								
2			1155	1215						
3							1220	1240		
4									1245	1305
Photometric					1200	1235				

The original test plan called for all of the low altitude flights to be flown at an altitude of 100 feet above ground level (AGL) and at a speed of 60 knots indicated airspeed (KIAS). The requirement for radar tracking of the aircraft precluded the 100-foot AGL requirement due to the extremely flat terrain of Aberdeen Proving Ground and the height of the trees. To insure radar coverage, flights were conducted at a pressure altitude of 300 feet. Tracking for the NOE test was accomplished by the use of a second helicopter flying directly above the scout helicopter at a pressure altitude of 300 feet.

At each target detection call, the position of the aircraft and its altitude were electronically recorded and the position was plotted on an overlay sheet which contained a record of the aircraft's flight path for that test flight. As additional backup data, a recording was made of all radio conversation during the test flights and an observer rode in the rear seat on each of the 300-foot flights and kept a written rcord of the target detections and times of detection. Also, inflight, 260° motion pictures were made of all the 1-to-40-foot altitude flights and of nine of the 300-foot altitude flights. This redundance of data enabled the experimenter to resolve any data gaps which might have occurred in any one of the four information sources.

Results

The overall target detection performances of the subjects is given in Table 10.

One of the main factors of any target detection task is the amount of extraneous information available in the form of noninterest targets affecting the detection performance of the observer/crew. This study calls the factor "Clutter" and defines it as:

1 – (Number of targets detected/Number of sightings reported).

TABLE 10

Targets Detected
(Percent)

Target Type	Crews	APG Observers	NWC Observers	NOE
Ordnance	40	42	76	44
Day-Glo Boxes	76	42	--	67
Sails	48	--	--	--
Overall	55	42	76	55
Clutter Factor	59	58	22	57

The much greater clutter factor of the Aberdeen Proving Ground groups was not unexpected as the area over which it was possible to fly the tests is also used by other agencies of the Army for test purposes and noninterest targets abound. In contrast, the NWC range over which the tests were flown is primarily a target range and the test targets were the range targets; therefore, noninterest targets were not as plentiful.

The overall results of these two low altitude target detection efforts (Aberdeen Proving Ground and NWC) using the OH-58 helicopter are given in Table 11 in terms of target size, best detection range achieved at the lowest AGL, best overall detection range and the AGL at which it was accomplished. The results also provide target detection information about like targets, V-62 vans in flat terrain (APG) and in rough terrain (NWC), and about high visibility targets (Day-Glo orange boxes) and ordnance targets in the same terrain conditions.

The NOE crews were not included in Table 11 as they were flying a pattern type of reconnsaissance rather than a course line mission and the aircraft heading at the time of detection could be a factor. Table 12 provides the detection information for the NOE crews.

The detection ranges for several of the targets in the NOE test were greater than the ranges at the higher AGL, but an inspection of the relative bearings between the target and the aircraft headings shows that five of the six relative bearings are $35^\circ \pm 10^\circ$ with the largest at 54°. It seems that at NOE altitudes a relative bearing of approximately 45° allows the target to appear at its maximum apparent size.

Discussion

The results of these tests, given in the form of target detection range for specific aircraft AGL, are of interest when aircraft tactics and aircraft weapon design are being considered. Table 11 gives the overall results of the 80 - to 400-foot AGL detection performances using stationary targets and flying at 60 KIAS, and shows that if the scout aircraft are flying between 80 and 100 feet AGL and the target has a volume less than 2,000 cubic feet, the maximum detection range achieved in these tests was around 1,000 meters. Increasing the AGL by 50 feet gave another 100 meters in maximum detection range. The maximum detection range of around 2,300 meters was achieved at an AGL of 340 feet.

TABLE 11

Low Altitude Target Detection Efforts
(APG and NWC)

Target	Description	Volume (Cubic Feet)	Minimum Detection AGL: Minimum AGL (Feet)	Minimum Detection AGL: Range (Meters)	Maximum Detection Range: Maximum Range (Meters)	Maximum Detection Range: AGL (Feet)
NWC 3	M-211 Trucks (3)	1674 ea	80	1060	1800	280
NWC 6	M-4 Tractor	1273	100	930	1020	210
NWC 10	V-62 Van	1715	80	580	740	320
APG 5	V-62 Van w Antenna[a]	3405	84[b]	570	640	249[c]
NWC 23	Bridge, 2 lane	148,200	100	460	785	150
NWC 22	Supply Dump	69,445	100	420	660	250
NWC 24	Bridge, 1 lane	102,400	90	380	1470	260
NWC 19	M-37 Truck (3)	578 ea	90	280	1130	190
NWC 26	Pickup Truck	665	90	280	890	230
NWC 11	75mm SkySweep Gun (3)	1944 ea	90	230	550	270
NWC 16	V-62 Van w Antenna	2910	90	220	1060	340
APG 4	Day-Glo Orange Box	32	80[b]	140	840	214[b]
NWC 15	M-47 Tank	2620	110	250	510	200
NWC 17	Truck, Amphibious	2259	110	580	1290	310
NWC 4	M-535 Van	1678	120	1160	2200	330
APG 1	M-258 Van	2397	120[c]	620	1800	362[b]
NWC 12	Searchlight (3)	307 ea	120	310	441	150
NWC 13	M-38 Jeep (2)	177 ea	120	190	470	300
NWC 14	75mm SkySweep Gun	1944	120	190	280	160
NWC 7	Bridge, 1 lane	21,760	140	370	760	280
NWC 27	Tractor and Tanker	3115	160	880	1030	220
APG 2	Day-Glo Orange Box	32	186[b]	230	600	351[c]
NWC 9	V-62 Van	1715	190	670	830	250
APG 3	M-259 Van w Antenna	3394	189[c]	570	1880	251[b]
NWC 2	105mm Howitzer (3)	720 ea	210	1060	1060	210
NWC 1	M-48 Tank	2881	220	610	2320	340
APG 12	Day-Glo Orange Box	64	239[b]	220	400	328[b]
NWC 5	90mm Gun Mount	1637	250	637	1000	330
APG 10	Day-Glo Orange Box	32	268[b]	210	640	361[b]
APG 13	M-21 Rocket Launcher (3)	422 ea	296[b]	950	950	296[b]
APG 15	Day-Glo Orange Box	32	316[b]	400	600	419[b]
APG 14	M-21 Rocket Launcher	422	310[b]	200	500	362[b]
APG 6	M-38 Hard-Top Jeep	434	307[c]	100	500	434[b]
APG 7	Day-Glo Orange Box	64	329[c]	1600	1600	329[c]
APG 9	XM387E1 Missile Truck	1316	370[c]	1240	1290	392[c]
NWC 8	Truck, Amphibious	2259	370	700	700	370

[a]This van had been extended by 3 feet.

[b]Crew score

[c]Observer score

TABLE 12

NOE Maximum Detection Range

Target	Description	Volume (Cubic Feet)	Maximum Range (Meters)	Aircraft Heading (Degrees)	Target Heading (Degrees)
APG 10	Day-Glo Orange Box	32	1280	180	36
APG 11	XM387E1 Missile Truck	1316	400	210	92
APG 12	Day-Glo Orange Box	64	1470	255	106
APG 13	M-21 Rocket Launcher (3)	422 ea	350	285	69
APG 14	M-21 Rocket Launcher	422	370	260	35
APG 15	Day-Glo Orange Box	32	520	130	76

Two tactical limitations of this study are immediately apparent: (1) the 300-feet AGL necessary for radar tracking (an AGL of 300 feet has been, for the helicopter, the altitude at which the majority of enroute combat losses have occurred); and (2) the use of stationary targets (a moving vehicle type target can usually be detected at much greater distance because of dust, exhaust smoke and the fact that the target is moving and the background is not).

HELHAT III

Method

The final portion of the study was concerned with the assembly of all of the data gathered in the 1972 and the 1973 flight tests into one body of target detection information. This information was used to establish the significant parameters concerning the detection of stationary, passive targets by trained and experienced U. S. Army aviators.

The data used were taken from the 34 "first flights" of the NWC flight tests, the 24 flights of the APG low-level flight tests, and the 6 NOE flights. This data encompassed approximately 850 target detections. The measures/variables considered were:

1. AGL — Aircraft height above the ground, measured in feet.
2. AS — Aircraft speed, measured in knots per hour.
3. TA — Apparent target area, computed and given in square feet.
4. MTAI — Maximum target acquisition interval, given in seconds.
5. TER — Roughness of terrain, given in a roughness code.
6. CL — Target acquisition difficulty, given in a difficulty code.
7. FG — Target/foreground conspicuity, given in percent of conspicuity.
8. OC — Target's distance perpendicular to course line, given in meters.
9. PRB — Plotted relative bearing, angular distance from aircraft to target, given in degrees.
10. ERB — Estimated relative bearing, crewman's estimate of PRB.
11. PR — Plotted range; range from aircraft to target, given in meters.
12. ER — Estimated range; crewman's estimate of PR.
13. EXP — Combat experience level of crewman, measured in hours code.
14. ACFT — Aircraft used, given in a numeric code.
15. POS — Crewman position given in a numeric code.
16. HDG — Target heading, given in degrees.

17.	TC	Aircraft heading, given in degrees.
18.	L	Overall length of the target, given in inches.
19.	H	Overall height of the target, given in inches.
20.	W	Overall width of the target, given in inches.
21.	VOL	Volume of the target, given in cubic feet.
22.	CF	Clutter factor. Difference between number of sightings and detections.
23.	VIS	Visibility, given in miles.
24.	CLD	Amount of cloud cover, given in tenths.
25.	BE	Bearing error. Difference between estimated and actual target range, given in meters.
26.	RE	Range error. Difference between estimated and actual target range, given in meters.
27.	EAR	Equivalent acquisition range. Target ranges adjusted to a 100-foot AGL, given in meters.
28.	α	The sighting angle of the observer to the target, based on aircraft altitude and slant range.
29.	BG	Target/Background conspicuity, given in percent of conspicuity.

Even though many of the variables used for the Franklin-Whittenberg prediction model that was developed for the U. S. Army Human Engineering Laboratory (HEL) in 1965, were included in the HELHAT list, there were others that were different because in HELHAT we had experimental data sufficient to replace the probability elements with real data. The derivation of some of the HELHAT variables requires explanation so that the reader can apply this work to his own situation.

The Apparent Target Area (TA) presented the most confusing problem of any of the variables. This was a three-dimension problem to determine: "What size target did the crewman see from the position at which he reported the detection?" The contributing factors readily apparent were:

a. Heading of the aircraft.

b. Relative bearing to the target.

c. Height of the aircraft above the ground.

d. Range to the target.

e. Height, length, and width of the target.

f. Heading of the target.

g. Sighting or depression angle to the target.

h. Difference between the aircraft and target headings.

The amount of a target side that is visible is dependent upon the angle at which it is seen; thus, the amount of any two adjacent sides that is visible will be maximum at 45°. Therefore, using this rationale (Fig. 7), the following formula was developed to provide this study with a close approximation of the apparent size of the target at the time of detection:

$$TA = [\,(H \cdot L \cdot \cos B) \sin \emptyset + (H \cdot L \cdot \cos B) \cos \alpha + (H \cdot W \cdot \sin B) \cos \emptyset + (L \cdot W \cdot \sin \alpha)\,]$$

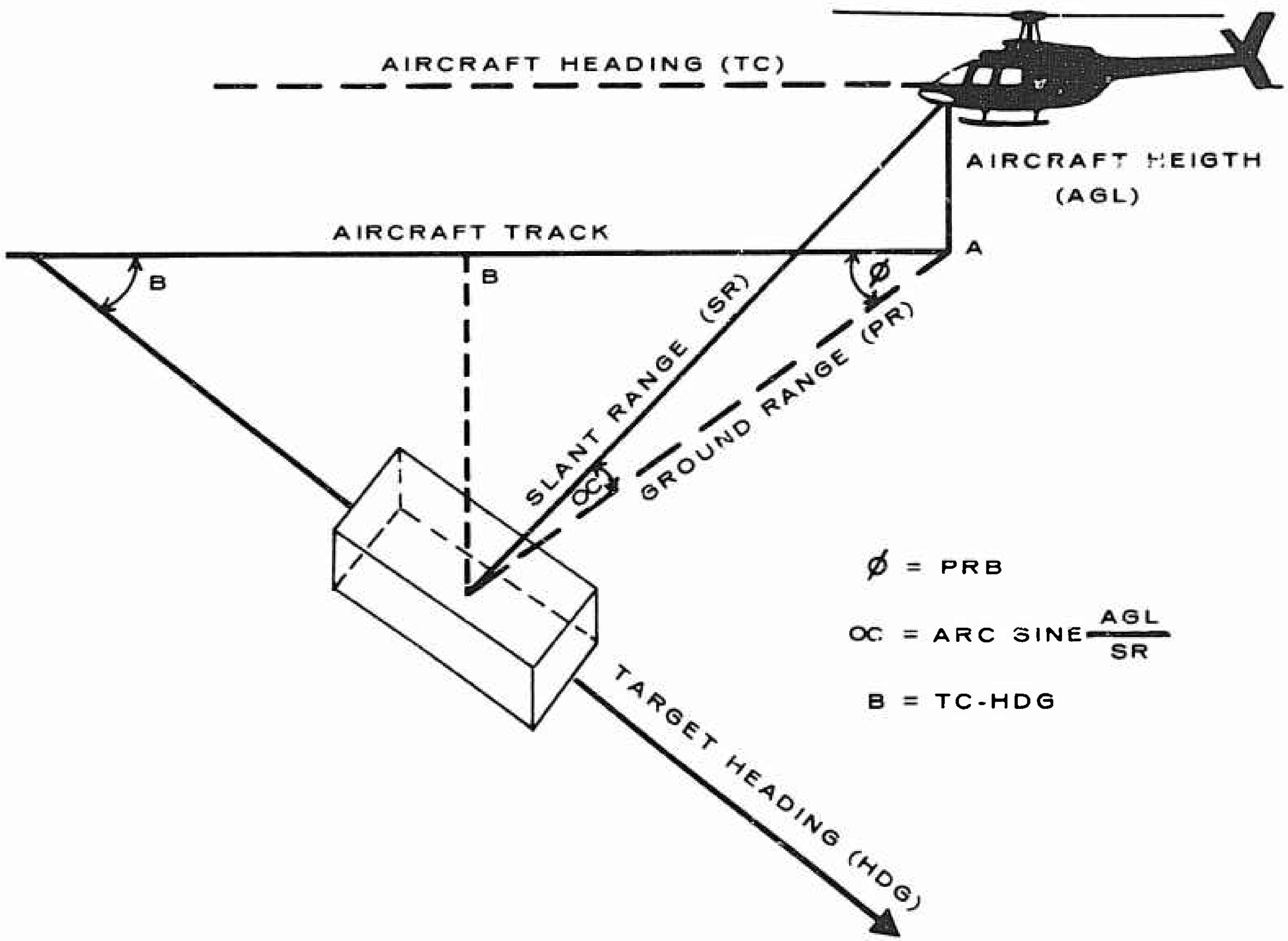

Fig. 7. Apparent target area computation rationale.

MTAI, the maximum target acquisition interval, is the maximum amount of time that a target was available to be seen with the end limit set at the time the relative bearing to the target is $90^{o}/270^{o}$. This is the maximum value of the distance AB (Fig. 7) divided by an airspeed of 60 knots. This value was taken from the film data and checked against each TAD/AS for each detection. The distance AB is called TAD (Target Acquisition Distance) in the calculations and MTAD for greatest value of TAD achieved for each particular target.

Clutter Factor (CF) is one variable that has evoked a considerable amount of discussion. Clutter is and will continue to be an important factor in the helicopter's battle role until someone devises a method of instant battlefield policing. For a helicopter to direct fire or to fire at an already ineffective and/or disabled target is a waste of ammunition, guided missiles are not that expendable. What is more important, the helicopter may well be exposed to effective enemy action during this abortive procedure. In this study, the term Clutter Factor represented as much as possible, this very real problem of air-to-ground target acquisition/detection. It was computed as:

$$CF = 1 - \left(\frac{\text{Number of briefed targets reported}}{\text{Number of target sightings reported}}\right)$$

TER is the coded value for the roughness of the terrain surrounding a target. This code is based on the tangent of the angle generated by the difference between the target elevation and the highest terrain within a 10,000-foot radius of the target, with 1 equal to a 0 to $.99^{o}$ angle of slope and 10 equal to a 9^{o} or greater angle of slope.

CL, the class of target difficulty, was a subjective measure which took into account the degree of target cover, the off-course distance, actual target size and primarily the flight-camera-derived MTAI values. The difficulty range was from 1 for difficult-to-see targets to 12 for the easy-to-see targets.

EAR, the equivalent acquisition range, was devised so that the reader might be provided with a uniform method of evaluating a value of PR with the other values of PR. The assumption was made, for the purpose of providing a simplified comparison method with a 100-foot base value for AGL, that the values of PR varied according to AGL and the following formula was used to compute EAR:

$$EAR = PR\ (100/AGL)$$

Most of these 29 measures are included in the equation:

$$100 - \frac{MTAD - TAD}{MTAD} = aAGL + bAS + cTA + dTER + eCL + fBG + gFG + hOC + iPRB + jPR + kEXP + lACFT + mPOS + nHDG + oTC + pL + qH + rW + sVOL + tCF + uVIS + vCLD + wBE + xRE + yOC,$$

where "a" through "y" are computer-developed coefficients.

This linear equation was developed for each of the approximately 850 target detections that were documented and a stepwise multiple regression statistical procedure was applied to these equations to determine which of the 25 variables contributed significantly to the detection of the stationary targets from the helicopters. The use of the linear equation was suggested by Dr. Robert C. Williges of the Aviation Research Laboratory, Institute of Aviation, University of Illinois. He stated that, based on the results of the many experiments concerned with pilot behavior he had observed at the Aviation Research Laboratory, the best prediction of this

behavior closely corresponded to a linear equation. Additionally, previous studies in aircrew performance performed at HEL in which a multiple regression technique was used indicated the superiority of the linear equation over more complicated equation forms as a predictor of aircrew performance.

Results

The regression procedure was used on all of the scores. In addition, it was used on selected groups of scores such as the box-target scores, the ordnance-target scores, the target scores for the crews, and those for the observers, the NOE scores, all of the scores from APG, the OH-58 scores, the front AH-1 scores, the rear AH-1 scores, all of the AH-1 scores, and all of the scores from NWC. In this way it was possible to isolate the significant variables and assign a coefficient to each of them.

These analyses of the data allowed the comparison of the effects of terrain, aircraft type, crew size, observer position, target contrast, and flight level on the prediction equations and indicated the significant variables that were peculiar to a specific situation. The run categories and conditions used for the analyses were set up so that each computer run considered one category with that category analyzed for each of the four conditions. These run categories and conditions are given in Table 13.

The actual computer printout results of the analyses are given in Appendix C along with an explanation of the programs, the categories, and the conditions. Tables 14 through 25 give the sign of the coefficient and the Beta weighting order of the variables for analyses, Conditions 1 and 4, that were significant in their respective analysis.

The Beta weighting order for the variables was determined by computing the Beta value[4], $B = \left(\frac{\text{Sigma of Variable}}{\text{Sigma of Condition Scores}}\right) \cdot \text{Coef. Variable}$; these values were then rank-ordered to provide numbers in the tables.

Condition 1 considered all of the data in the particular category except for the conspicuity values and the range and bearing estimate errors. This allowed the program to analyze the maximum number of cases for each category. Condition 4 considered all of the equations in the particular category that had no missing data.

Table 14 provides the overall results of the HELHAT program. It indicated that the important aspects of target acquisition for the 268 full-data cases (Condition 4) were as follows:

1. Sighting Angle
2. Terrain Slope/Roughness
3. Target Background Conspicuity
4. Target Foreground Conspicuity
5. Target Distance from Flight Path
6. Aircraft Heading
7. AGL, Aircraft True Altitude
8. Bearing Estimate Error

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[4] Garrett, H. E. Statistics in psychology and education. New York: Longmans, Green, 1966.

9. Aircraft to Target Range

10. Apparent Size of the Target

When the same data were analyzed, not considering conspicuity and range and bearing estimate errors (Condition 1), there were some changes in significant variables. These 831 cases added Target Difficulty, Relative Bearing to Target, Cloud Cover, Target Length, and Target Volume to the list of significant variables, but did not consider Apparent Target Size, Terrain Slope, and Bearing Estimate Error Significant.

The listed + and – symbols are explained as follows for each of the variables used in the regression equation:

AGL +	as the aircraft's height increased there was a significant effect on target acquisition.
AS +	as the airspeed increased there was a significant effect on target acquisition.
TA +	as the apparent size of the target increased there was a significant effect on target acquisition.
TER +	as the slope of the land got steeper, there was a significant effect on target acquisition.
CL +	as the difficulty of the target increased (1 = Most difficult target to 12 = least difficult target), there was a significant effect on target acquisition.
BG +	as conspicuity of the target and background increased, there was a significant effect on target acquisition.
FG +	as the conspicuity of the target and the foreground increased, there was a significant effect on target acquisition.
OC +	as the distance of the target from the aircraft's path increased, there was a significant effect on target acquisition.
PRB +	as the relative bearing of the aircraft to the target increased, there was a significant effect on target acquisition.
PR +	as the range from the aircraft to the target increased there was a significant effect on target acquisition.
EXP +	as the combat flight time of the flyers increased, there was a significant effect on target acquisition.
ACFT +	the AH-1 had a significant effect on target acquisition.
ACFT –	the OH-58 observer had a significant effect on target acquisition.
POS +	the rear seat and/or crew positions had a significant effect on target acquisition.
POS –	the front and/or left seat had a significant effect on target acquisition.
HDG +	as the true heading (0^{o} – 360^{o}) of the target increased, there was a significant effect on target acquisition.

TABLE 13

Analyses Categories and Conditions

Run 1.	All OH-58 Low Level Flights
Run 2.	APG Low Level Observer Flights
Run 3.	NWC OH-58 Flights
Run 4.	APG Low Level Box Targets
Run 5.	All Low Level OH-58 Ordnance Targets
Run 6.	APG Low Level Ordnance Targets
Run 7.	AH-1 Front Observer Flights
Run 8.	AH-1 Rear Observer Flights
Run 9.	APG Low Level Crew Flights
Run 10.	APG Low Level Crew Box Targets
Run 11.	APG Low Level Crew Ordnance Targets
Run 12.	NOE Flights
Run 13.	NOE Box Targets
Run 14.	NOE Ordnance Targets
Run 15.	All Low Level Flights
Run 16.	All AH-1 Flights
Run 17.	All NWC Flights
Run 18.	All APG Low Level Flights
Run 19.	APG Low Level Observer Box Targets
Run 20.	APG Low Level Observer Ordnance Targets
CONDITION 1.	Considers all variables except conspicuity, and range and bearing error estimate; maximum number of cases.
CONDITION 2.	Considers only input equations that contain conspicuity values; does not consider error estimates.
CONDITION 3.	Considers only input equations that contain range and bearing error estimates; does not consider conspicuity.
CONDITION 4.	Considers only input equations that contain all of the variables.

TABLE 14

Low Level Flights

	ALL FLIGHTS		HWC FLIGHTS		APG FLIGHTS	
VARIABLE	COND. 1	COND. 4	COND. 1	COND. 4	COND. 1	COND. 4
1. AGL	+ 6	+ 7	+ 5		+ 6	+ 5
2. AS						
3. TA		- 10				
4. TER		+ 2		- 1	*	*
5. CL	- 3		- 2			- 1
6. BG		- 3				
7. FG		+ 4				
8. OC	- 7	- 5	- 7		- 8	- 7
9. PRB	- 8		- 6			- 6
10. PR	- 9	+ 9	- 8	- 3	+ 7	+ 8
11. EXP						
12. ACFT				+ 4		
13. POS					+ 1	+ 3
14. HDG						
15. TC	+ 5	- 6	- 10	- 2	+ 5	+ 4
16. L	- 10		- 9		+ 3	
17. H						
18. W					- 2	
19. VOL	+ 4		+ 4			
20. CF						
21. VIS						
22. CLD	- 2		- 1			
23. BE		- 8				
24. RE						
25. α	- 1	- 1	- 3		- 4	- 2
N	831	268	656	105	175	163

*This variable was constant for these flights.

TC + as the true course of the aircraft increased ($0^o - 360^o$), there was a significant effect on target acquisition.

L+, H+, W+, VOL+ as these dimensions of the target increased, there was a significant effect on target acquisition.

CF + as the difference between the number of reported targets and targets of interest increased, there was a significant effect on target acquisition.

VIS + increased visibility range had a significant effect on target acquisition.

BE + an increase in the amount of bearing estimation error by the observer had a significant effect on target acquisition.

α + an increase in sighting angle had a significant effect on target acquisition.

For the cases in which the variable is represented by a –, substitute "decrease" for "increase" in the preceding statements.

All data in this section for flights performed at NWC are for those flights in which the observer was flying the test course for the first time. This was done to eliminate any learning effect.

Table 15 is a comparison of the flights performed at NWC using OH-58 and AH-1 aircraft. Condition 4 for the OH-58 flights shows two variables with the same Beta weighting; this is not an error—they were the same even when carried to eight decimal places. This appears in Tables 15, 16 and 19.

Table 16 compares the NWC and APG OH-58 observer flights to indicate the effect of flat versus mountainous terrain. The target foreground and target background effects seem to have been the major Condition 4 differences between the two test areas. This may have been in part due to the small number of NWC targets that had contrast data available. Table 17 compares the

Table 17 compares the front and rear observer position in the AH-1. The Condition 1 analysis showed a few differences; the rear position was affected by AGL and clutter while the front was not. The effect of VIS on the front position and that of CLD for the rear position really imply the same thing—visibility is greater when cloud cover is less where haze is not a factor.

Table 18 compares the OH-58 APG crew flights and the APG observer flights or, stated otherwise, the value of two men versus one man on the job. The Condition 4 analysis indicates that target ground conspicuity was the major factor for the observer while the crew was not affected by it but was affected by the difficulty classification, length and width of the targets and the relative bearing estimate. The Condition 1 analysis showed AGL, range to the target, relative bearing to the target, and aircraft heading entering into the observer's analysis, while the crew's analysis essentially did not change.

Table 19 is similar to Table 16 except that it only considered ordnance targets; this changed only the APG analysis. Instead of the major Condition 4 difference being the effect of the target ground on the APG flights, several other variables were included for the APG flights; they were apparent size of the target, difficulty classification, aircraft heading, length and volume of the target, clutter factor, range estimate error and sighting angle.

Table 20 which considers only ordnance targets, provides the difference in factors affecting the OH-58 single observer and the crew at APG. It indicates that under Condition 4 apparent target size affected the crews and the actual target length affected the observers. The difficulty classification of the target and the distance of the target from the aircraft's track affected only the crews, while the relative bearing to the target, the target heading and the sighting angle affected only the observers. The aircraft heading and the range to the target were significant factors to both groups.

TABLE 15

NWC Flights

	ALL FLIGHTS		AH-1 FLIGHTS		OH-58 FLIGHTS	
VARIABLE	COND. 1	COND. 4	COND. 1	COND. 4	COND. 1	COND. 4
1. AGL	+ 5		+ 5			
2. AS			+ 3			
3. TA						
4. TER		- 1				
5. CL	- 2		- 2		- 1	
6. BG						
7. FG						
8. OC	- 7		- 9	- 4	- 3	- 2
9. PRB	- 6					
10. PR	- 8	- 3	- 8	+ 5		+ 2
11. EXP						
12. ACFT		+ 4	*	*	*	*
13. POS						
14. HDG			+ 7			
15. TC	- 10	- 2	+ 6		+ 4	+ 1
16. L	- 9					
17. H				+ 2		
18. W						
19. VOL	+ 4					
20. CF						
21. VIS						
22. CLD	- 1		- 1	- 1		
23. BE						
24. RE						
25. α	- 3		- 4	- 3	- 2	
N	656	105	451	70	205	35

*This variable was constant for these flights.

Table 16

OH-58 Observer Flights

	ALL FLIGHTS		NWC FLIGHTS		APC FLIGHTS	
VARIABLE	COND. 1	COND. 4	COND. 1	COND. 4	COND. 1	COND. 4
1. ACL		+ 5			+ 3	
2. AS						
3. TA		- 9			- 6	
4. TER		+ 1			*	**
5. CL	- 1	+ 2	- 1			
6. BG		- 3				- 2
7. FC		+ 4				+ 1
8. OC	- 2	- 7	- 3	- 2	- 5	- 4
9. PRB	- 5				- 4	
10. PR		+ 8		+ 2	+ 2	+ 3
11. EXP						
12. ACFT	*	*	*	*		
13. POS						
14. HDG						
15. TC	+ 3	+ 6	+ 4	+ 1	+ 1	
16. L						
17. H						
18. W						
19. VOL						
20. CF						
21. VIS						
22. CLD						
23. BE						
24. PE						
25. oc	- 2		- 2			
N	281	109	205	35	76	75

*This variable was constant for these flights.

TABLE 17

AH-1 Flights

	ALL FLIGHTS		FRONT POSITION		REAR POSITION	
VARIABLE	COND. 1	COND. 4	COND. 1	COND. 4	COND. 1	COND. 4
1. AGL	+ 5				+ 6	
2. AS	+ 3		+ 2	+ 1	+ 3	
3. TA						
4. TER						
5. CL	- 2		- 1		- 2	+ 1
6. BC						
7. FC						+ 3
8. OC	- 9	- 4	- 6	- 3	- 8	
9. PRB						
10. PR	- 8	+ 5	+ 7	+ 2	- 7	
11. EXP						
12. ACFT	*	*	*	*		
13. POS					*	*
14. HDG	+ 7					
15. TC	+ 6					+ 4
16. L						
17. H		+ 2	- 5			
18. W						
19. VOL						
20. CF					- 4	
21. VIS			+ 4			- 2
22. CLD	- 1	- 1			- 1	
23. BE						
24. RE						
25. α	- 4	- 3	- 3		- 5	
N	451	70	245	35	206	35

*This variable was constant for these flights.

TABLE 18

APG Low Level Flights

	ALL FLIGHTS		OBSERVER FLIGHTS		CREW FLIGHTS	
VARIABLE	COND. 1	COND. 4	COND. 1	COND. 4	COND. 1	COND. 4
1. AGL	+ 6	+ 5	+ 3			
2. AS						
3. TA			- 6			
4. TFR	*	*	*	*	*	*
5. CL		- 1			- 1	- 1
6. BG				- 2		
7. FG				+ 1		
8. OC	- 8	- 7	- 5	- 4	- 5	- 6
9. PRB		- 6	- 4			
10. PR	+ 7	+ 8	+ 2	+ 3	+ 6	+ 7
11. EXP						
12. ACFT						
13. POS	+ 1	+ 3				
14. HDG						
15. TC	+ 5	+ 4	+ 1		+ 4	+ 5
16. L	+ 3				+ 2	+ 2
17. H						
18. W	- 2				- 3	- 3
19. VOL						
20. CF						
21. VIS						
22. CLD						
23. BE						- 4
24. RE						
25. α	- 4	- 2				
N	175	163	76	75	99	88

*This variable was constant for these flights.

TABLE 19

OH-58 Low Level Ordnance Targets

	ALL FLIGHTS		NWC FLIGHTS		APG FLIGHTS	
VARIABLE	COND. 1	COND. 4	COND. 1	COND. 4	COND. 1	COND. 4
1. AGL		+ 6				
2. AS						
3. TA					- 7	- 8
4. TER		+ 1			*	*
5. CL	- 1		- 1		- 1	- 1
6. BG		- 3				
7. FG						+ 6
8. OC	- 4	- 8	- 3	- 2	- 5	- 8
9. PRB		- 9				
10. PR		+ 10		+ 2	+ 8	+ 9
11. EXP						
12. ACFT	*	*	*	*		
13. POS						
14. HDG		+ 7				
15. TC	+ 3	+ 5	+ 4	+ 1	+ 6	+ 5
16. L					+ 4	+ 4
17. H		- 4				
18. W						
19. VOL					+ 9	+ 10
20. CF					+ 3	+ 3
21. VIS						
22. CLD						
23. BE						
24. RE						- 11
25. α	- 2	- 2	- 2		- 2	- 2
N	294	120	205	35	89	85

*This variable was constant for these flights.

TABLE 20

APG Low Level Ordnance Targets

	ALL FLIGHTS		CREW FLIGHTS		OBSERVER FLIGHTS	
VARIABLE	COND. 1	COND. 4	COND. 1	COND. 4	COND. 1	COND. 4
1. AGL						
2. AS						
3. TA	- 7	- 8	- 4	+ 3		
4. TER	*	*	*	*	*	*
5. CL	- 1	- 1	- 1	- 1		
6. BG						
7. FG		+ 6				
8. OC	- 5	- 7	+ 7			
9. PRB			+ 8		- 5	- 4
10. PR	+ 8	+ 9	+ 9	+ 4	+ 7	+ 6
11. EXP						
12. ACFT						
13. POS						
14. HDG			+ 6			- 5
15. TC	+ 6	+ 5	+ 5	+ 2	+ 4	+ 2
16. L	+ 4	+ 4	+ 2		- 3	- 1
17. H					- 2	
18. W						
19. VOL	+ 9	+ 10			+ 6	
20. CF	+ 3	+ 3				
21. VIS						
22. CLD						
23. BE						
24. RE		- 11				
25. α	- 2	- 2	- 3		- 1	- 3
N	89	78	43	40	46	45

*This variable was constant for these flights.

Table 21 considers the box-type targets used in the APG test only. The Condition 4 analysis indicated that both groups were affected by the plotted range to the target and additionally the observers were affected by the distance of the target from the aircraft's track and the width of the target, while the crews were affected by the height of the target.

Table 22 compares the NOE and low-level crew flights. The Condition 4 analysis indicated that the apparent size and height of the target and the sighting angle affected only the NOE crews while the distance of the target from the aircraft's track, the difficulty classification, the relative bearing estimate error, the length of the target, and the aircraft's heading additionally affected only the low-level crews. Both groups were affected by the plotted range to the target and the width of the target.

Table 23, NOE Targets, indicates that the experience level of the crew had an effect on box-target acquisition. This was the only case in the 80 data analyses in which experience level was a significant variable. The number of NOE ordnance targets reported was quite small; therefore, it should be considered that the analysis of this segment indicated a trend rather than a significant effect.

Table 24 indicates that apparent target size and sighting angle were the only variables that were common for the Condition 1 analyses of ordnance target acquisition from low-level and NOE. No variable was common in the Condition 4 analysis.

Table 25 indicates that there were no common variables in the target acquisition of the box targets for NOE and low-level crews other than target dimensions, the NOE crew found target length significant while the low-level crew cued on target height when target conspicuity and range on bearing error estimates were considered in the data analysis.

Table 26 indicates the density of the occurrence of the various variables regardless of sign in Tables 14 through 25. It is interesting to note that sighting angle and plotted range appaear in the top five variables of both conditions of low-level and NOE flights; in addition, apparent target size is included in both conditions of the NOE flights. Both conditions of the low-level flights have the same top five variables.

Table 27 lists the coefficients of multiple correlation (Rho) achieved in each of the data category runs and for each condition of the run. The value of Rho is the correlation between target acquisition score and the independent variables shown as "significant" by the stepwise multiple regression analysis and indicates how accurately the "significant" variables represent the value of target acquisition score when combined in accordance with the "significant" linear equation. Rho^2 gives the proportion of the variance of target acquisition success attributable to the joint action of the "significant" variables.

All of the values of Rho--except those for Run 3, Condition 2 and Run 14, Conditions 1 and 2--were significant at the .01 level; these three were significant at the .05 level.

Discussion

The HELHAT flight tests have provided a large amount of information concerning observer and crew performance in detecting/acquiring stationary ordnance and high visibility targets while flying a simulated low-level route reconnaissance mission and a limited amount of information concerning NOE reconnaissance. It was determined in the initial phase of this series of tests that the observer could function equally well in either seat of the AH-1. The left seat

TABLE 21

APG Low Level Box Targets

	ALL FLIGHTS		CREW FLIGHTS		OBSERVER FLIGHTS	
VARIABLE	COND. 1	COND. 4	COND. 1	COND. 4	COND. 1	COND. 4
1. AGL						
2. AS						
3. TA						
4. TER	*	*	*	*	*	*
5. CL						
6. BG						
7. FG						
8. OC					- 3	- 3
9. PRB						
10. PR	+ 2	+ 3	+ 2	+ 2	+ 2	+ 2
11. EXP						
12. ACFT						
13. POS	+ 1	+ 1				
14. HDG						
15. TC						
16. L						
17. H				- 1		
18. W					+ 1	+ 1
19. VOL	- 3	- 2	- 1			
20. CF						
21. VIS						
22. CLD						
23. BE						
24. RE						
25. α						
N	86	78	56	48	30	30

*This variable was constant for these flights.

TABLE 22

APG Crew Flights

	ALL FLIGHTS		NOE FLIGHTS	
VARIABLE	COND. 1	COND. 4	COND. 1	COND. 4
1. AGL				
2. AS				
3. TA			- 3	- 4
4. TER	*	*	*	*
5. CL	- 1	- 1		
6. BG				
7. FG				
8. OC	- 5	- 6		
9. PRB				
10. PR	+ 6	+ 7	+ 6	+ 5
11. EXP				
12. ACFT				
13. POS				
14. HDG			- 4	
15. TC	+ 4	+ 5		
16. L	+ 2	+ 2		
17. H			+ 2	+ 2
18. W	- 3	- 3		+ 3
19. VOL			- 5	
20. CF				
21. VIS			+ 1	
22. CLD				
23. BE		- 4		
24. RE				
25. oc				- 1
N	99	88	20	16

*This variable was constant for these flights.

TABLE 23

NOE Targets

	ALL		ORDNANCE TARGETS		BOX TARGETS	
VARIABLE	COND. 1	COND. 4	COND. 1	COND. 4	COND. 1	COND. 4
1. AGL						
2. AS						
3. TA	- 3	- 4	- 3			
4. TER	*	*	*	*		
5. CL						
6. BG						
7. FG						
8. OC						
9. PRB						
10. PR	+ 6	+ 5				
11. EXP					+ 4	+ 4
12. ACFT						
13. POS					*	
14. HDG	- 4					
15. TC						
16. L					+ 2	+ 2
17. H	+ 2	+ 2				
18. W		+ 3		- 1		
19. VOL	- 5		+ 4			
20. CF			+ 2		- 3	- 3
21. VIS	+ 1					
22. CLD						
23. BE						
24. RE				- 2		
25. α		- 1	- 1		- 1	- 1
N	20	16	8	5	12	11

*This variable was constant for these flights.

TABLE 24

Crew Ordnance Targets

	NOE		LOW LEVEL	
VARIABLE	COND. 1	COND. 4	COND. 1	COND. 4
1. AGL				
2. AS				
3. TA	- 3		- 4	+ 3
4. TER	*	*	*	*
5. CL			- 1	- 1
6. BG				
7. FG				
8. OC			- 7	
9. PRB			+ 8	
10. PR			+ 9	+ 4
11. EXP				
12. ACFT				
13. POS				
14. HDG			+ 6	
15. TC			+ 5	+ 2
16. L			+ 2	
17. H				
18. W		- 1		
19. VOL	+ 4			
20. CF	+ 2			
21. VIS				
22. CLD				
23. BE				
24. RE		- 2		
25. α	- 1		- 3	
N	8	5	46	45

*This variable was constant for these flights.

TABLE 25

Crew Box Targets

	NOE		LOW LEVEL	
VARIABLE	COND. 1	COND. 4	COND. 1	COND. 4
1. AGL				
2. AS				
3. TA				
4. TER			*	*
5. CL				
6. BC				
7. FC				
8. OC				
9. PRB				
10. PR			+ 2	+ 2
11. EXP	+ 4	+ 4		
12. ACFT				
13. POS	*			
14. HDG				
15. TC				
16. L	+ 2	+ 2		
17. H				- 1
18. W				
19. VOL			- 1	
20. CF	- 3	- 3		
21. VIS				
22. CLD				
23. BE				
24. RE				
25. α	- 1	- 1		
N	12	11	30	30

*This variable was constant for these flights.

TABLE 26

Variables by Density of Occurrence

CONDITION 1		CONDITION 4	
Low Level	NOE	Low Level	NOE
TC	VIS	PR	α
PR	TA	OC	W
OC	CF	TC	TA
CL	α	α	PR
α	PR	CL	EXP
AGL	HDG	FG	L
TA	VOL	POS	VOL
VOL		H	CF
AS		AGL	VIS
L		TA	RE
W		TER	
CF		BG	
PRB		PRB	
H		HDG	
VIS		CLD	
TER		L	
ACFT		W	
HDG		VOL	
CLD		CF	
		RE	
		AS	
		VIS	
		ACFT	
		BE	

TABLE 27

Coefficients of Multiple Correlation (RHO)

RUN NO.	FLIGHT CATEGORY	CONDITION 1		CONDITION 2		CONDITION 3		CONDITION 4	
		RHO	RHO^2	RHO	RHO^2	RHO	RHO^2	RHO	RHO^2
1	All OH-58 Low Level Flights	.39	.15	.55	.30	.42	.18	.68	.46
2	APG Observer Low Level Flights	.66	.44	.64	.41	.66	.44	.64	.41
3	NWC OH-58 Flights	.44	.20	.58	.34	.50	.23	.68	.47
4	APG Low Level Box Targets	.49	.24	.46	.21	.50	.25	.48	.23
5	All Low Level OH-58 Ordnance Targets	.40	.16	.68	.47	.44	.19	.75	.57
6	APG Low Level Ordnance Targets	.88	.77	.87	.76	.88	.78	.89	.78
7	AH-1 Front Observer Flights	.57	.33	.82	.68	.58	.33	.76	.58
8	AH-1 Rear Observer Flights	.43	.19	.55	.30	.50	.25	.64	.41
9	APG Low Level Crew Flights	.67	.45	.66	.43	.69	.47	.68	.46
10	APG Low Level Crew Box Targets	.47	.22	.41	.17	.49	.24	.45	.20
11	APG Low Level Crew Ordnance Tartets	.92	.84	.82	.66	.92	.84	.82	.66
12	NOE Flights	.91	.82	.91	.82	.97	.94	.97	.94
13	NOE Box Targets	.90	.80	.90	.80	.89	.78	.89	.78
14	NOE Ordnance Targets	.98	.96	.98	.96	.99	.99	.99	.99
15	All Low Level Flights	.34	.11	.55	.30	.34	.11	.62	.38
16	All AH-1 Flights	.33	.11	.61	.37	.37	.13	.67	.44
17	All NWC Flights	.39	.15	.57	.31	.39	.15	.66	.43
18	All APG Low Level Flights	.68	.46	.67	.45	.63	.40	.63	.39
19	APG Low Level Observer Box Targets	.58	.34	.58	.34	.58	.34	.58	.34
20	APG Low Level Observer Ordnance Targets	.87	.76	.86	.75	.88	.78	.88	.78

position in the OH-58 produced better results than either of the AH-1 positions but when statistically analyzed, the OH-58 results were not significantly different from the AH-1 results.

The second phase of the series provided some insight on the two-man crew versus a single observer and the flat terrain versus rough terrain questions. The tests indicated that the single observers and the crews performed at about the same level (43% vs 40%) in detecting available ordnance targets at APG, but that the crews were superior in detecting the high visibility orange box targets. The observer flights over flat terrain and the comparable ones over rough terrain provided the data shown in Table 11. (This table allows the reader to compare the detection ranges and altitudes for like targets placed on unlike terrain.) The NOE reconnaissance flights reported on were 'S' pattern flights along a briefed route. The percentage of available targets detected was about 4 percent greater than that of the low-level crews but on the high visibility orange box targets the detections were 10 percent less. Also, the pattern search required an average of 30 minutes to cover the same route the low-level crews covered in 6 minutes.

The use of the step-wise, multiple-regression analysis to provide us with prediction equations and significant variables appears to have accomplished the final task. It would be wise to consider, the NOE information as trend guides due to the small number (20) of acquisitions. The low-level information based on 831 acquisitions has, we feel, a large enough sample size to be considered authoritative for any of the test conditions presented. One problem associated with NOE operations that did occur and is important to planners, is the disorientation problem. Only three of the six crews performing the NOE tests flew the briefed route; one crew flew part of the route before becoming disorientated but was able to locate the end point of the course, the other two crews became hopelessly disorientated part way along the route and had to be redirected back to the air field at APG by the monitor helicopter.

RECOMMENDATIONS

The consistent sameness of results being achieved by experimenters in air-to-ground acquisition of stationary targets indicates that this type of research should be redirected to determine what the detection/acquisition/ranges are for moving targets and the implications thereof.

Of equal importance is the research needed to determine why one man sees a target and another, under like conditions, fails to see it. Additionally, it would be wise to reconsider some of the areas of study that have been proposed for ancillary equipment to aid men in performing the detection task until more information that is basic to the task has been discovered.

One of the primary sources of this information, and a virtually untapped research area, is the recorded eye-fixation points of an observer while he is searching for a target or of a pilot while performing nap-of-the-earth flight. Without knowledge of what information sources the operator is using, it is impossible to provide him with meaningful aids for the assigned task.

These types of measurements have, in the past, been very difficult to perform, but some have been made during actual flight in Army helicopters. The recent rapid advances in the development of solid state vidicons and other parallel development in electronic eye-movement measurement will now allow researchers to develop a relatively inexpensive system to record these eye fixations with a total "on-the-subject" weight of less than eight ounces. We recommend the immediate development of such a system and its wide use to help researchers provide real answers to these basic questions.

SECTION II

DATA COLLECTED ON THE HEL HELICOPTER ACQUISITION TEST

INTRODUCTION

This section of the Human Engineering Laboratory Helicopter Acquisition Test report contains all of the data gathered on the detection/acquisition of ordnance and nonordnance stationary targets (Tables 28 and 29) by operational helicopter crewmen while flying a simulated low-level route reconnaissance mission. There is also data from six Nap-of-the-Earth (NOE) 'S' pattern simulated route reconnaissance missions flown by combat returnee crews in an OH-58.

FLIGHT DATA

The flight data are presented in four series: series one (Table 30) is the Aberdeen Proving Ground (APG) Low Level crew data; series two (Table 31) is the APG Low Level observer data; series three (Table 32) is the Naval Weapons Center (NWC) observer data and series four (Table 33) is the APG NOE crew data. Many of the NWC targets were available to the observer on more than one of the legs of the three-leg course flown, hence, the 'N', 'S', 'A' preceding the target numbers.

The legend used is as follows:

FLIGHT	Flight number.
TGT	Target number.
ERB	Estimated relative bearing to the target in degrees.
PRB	Plotted relative bearing to the target in degrees.
HDG	Aircraft heading in degrees.
ER	Estimated range to the target in meters.
PR	Plotted range to the target in meters.
AGL	Height of the aircraft above the surface in feet.
ACFT	Type of aircraft.
POS	Observer's seat position in the aircraft.
AS	Indicated airspeed in knots.
EXP	Observer combat experience level code number.
EAR	PR extrapolated for a 100 foot AGL.

The combat experience level of the observers was coded such that a 'O' indicated no combat experience, each subsequent digit indicated a 200 hour increment of combat flight hours. As an example, Series 1, Flight 1, the EXP value of '6' indicates that the most combat hours either of the crewmen had ranged between 1001 and 1200 hours.

TABLE 28
List of Targets (NWC)

Target Number	Type of Target	Heading	Latitude	Longitude	Elevation	Length	Width	Height	Number of Items
1	M-48 Tank	281°[a]	36°10'40"	117°47'12"	6716	24' 5"	12'	9' 10"	1
2	105MM Howitzer	261°	36°11'36"	117°46'35"	6843	19' 8"	7' 1"	5' 2"	3
3	M-211 Truck	156°	36°11'33"	117°45'21"	6970	22' 5"	8'	9' 4"	3
4	M-535 Shop Van	348°	36°11'12"	117°46'20"	6853	21' 4"	8'	9' 10"	c
5	90MM Gun-Mount	043°	36°10'55"	117°46'21"	6974	20' 10"	8' 5"	9' 4"	1
6	M-4 Tractor	186°	36°11'05"	117°46'09"	6866	17' 6"	8' 1"	9'	1
7	Bridge; 1 Lane	071°	36°10'54"	117°45'45"	6902	170'	16'	8'	1
8	Truck, Amphibious	211°	36°10'46"	117°45'19"	6900	31'	8' 3"	8' 10"	1
9	Trailer, Radar V-62	021°	36°11'06"	117°45'02"	6952	20' 2"	8' 2"	10' 5"	1
10	Trailer, Radar V-62	206°	36°10'58"	117°45'05"	6930	20' 2"	8' 2"	10' 5"	1
11	75MM Sky Sweep Gun	061°	36°11'29"	117°43'59"	7543	25' 5"	8' 6"	9'	3
12	Search Light	046°	36°11'59"	117°43'25"	7681	7' 10"	5'	7' 10"	3
13	Jeep; 1/4 T, 4 X 4	146°	36°11'45"	117°43'39"	7657	11' 7"	5' 1"	3'	2
14	75MM Sky Sweep Gun	271°	36°11'.5"	117°43'37"	7658	25' 5"	8' 6"	9'	1
15	M-47 Tank	006°[a]	36°11'40"	117°43'30"	7624	23'	11' 7"	9' 10"	1
16	Trailer, Radar V-62[b]	126°	36°11'28"	117°43'46"	7591	20' 2"	8' 2"	17' 8"	1
17	Truck, Amphibious	196°	36°11'18"	117°43'40"	7536	31'	8' 3"	8' 10"	2
19	M-37 Truck	006°	36°11'36"	117°43'45"	7592	15' 4.75"	6' 1.5"	6' 1.5"	3
22	Supply Dump	066°	36°12'03"	117°43'38"	7704	---	---	---	d
23	Bridge; 2 Lane	081°	36°11'40"	117°43'20"	7592	228'	26'	25'[e]	1
24	Bridge; 1 Lane	121°	36°11'06"	117°46'42"	6850	160'	16'	40'[e]	1
26	Truck, Pickup (Chev)	261°	36°11'36"	117°46'37"	6834	16' 7"	6' 6"	6' 2"	1
27	Tractor and Tanker	226°	36°11'37"	117°43'16"	7592	42'	8' 2"	9' 1"	1

[a] Heading given is that of the gun in "Traveling Position".

[b] This radar van has a dish antenna; 6'2" L, 3'W, 7'3" H.

[c] There is also a T-33 fuselage and wing setting next to the van.

[d] This contains a M-211 Truck, 2 ea 8'x8'x10' huts, 2 ea 90MM guns, and numerous boxes. The heading given is that of the truck and is the general direction of the Supply Dump.

[e] This is height of bridge floor above terrain.

TABLE 29

List of Targets - (APG)

Target Number		Heading (Degrees)	Elevation (Feet)	Length (Inches)	Width (Inches)	Height (Inches)	Number of Items
1	M-258 Van	78	40	245	95	178	1
2	Day-Glo Orange Box	55	40	96	48	12	1
3	M-259 Van w Antenna	308	91	245	95	252	1
4	Day-Glo Orange Box	130	17	96	48	12	1
5	V-62 Van w Antenna	239	10	278	98	216	1
6	M-38 Jeep w Hard Top	70	12	139	61	73	1
7	Day-Glo Orange Box	11	6	96	48	24	1
8	XM387E1 Missile Truck	15	4	263	93	93	1
9	XM387E1 Missile Truck	90	14	263	93	93	1
10	Day-Glo Orange Box	36	3	96	48	12	1
11	XM387E1 Missile Truck	92	13	263	93	93	1
12	Day-Glo Orange Box	106	19	96	48	24	1
13	M-21 Rocket Launcher	69	25	165	79	56	3
14	M-21 Rocket Launcher	35	28	165	79	56	1
15	Day-Glo Orange Box	76	34	96	48	12	1

TABLE 30

FLIGHT DATA-SERIES 1

FLIGHT	TGT	ERR	PRR	HDG	ER	PR	AGL	ACFT	POS	AS	EXP	EAR
1	1	0	340	215	800	780	317	OH-58	CR	60	6	246
1	2	300	304	215	600	470	248	OH-58	CR	60	6	189
1	3	330	341	215	1000	1880	251	OH-58	CR	60	6	749
1	4	330	332	215	300	300	295	OH-58	CR	60	6	101
1	5	60	53	215	500	380	295	OH-58	CR	60	6	128
1	10	300	306	47	300	400	412	OH-58	CR	60	6	97
1	12	60	89	47	400	320	442	OH-58	CR	60	6	72
1	15	15	21	47	400	600	476	OH-58	CR	60	6	126
2	1	330	350	218	2000	1260	378	OH-58	CR	60	4	333
2	2	300	315	218	400	220	304	OH-58	CR	60	4	72
2	3	330	340	218	2000	1380	216	OH-58	CR	60	4	638
2	4	0	286	215	10	140	154	OH-58	CR	60	4	90
2	10	270	323	47	700	420	470	OH-58	CR	60	4	89
2	12	90	99	47	700	220	337	OH-58	CR	60	4	65
2	15	30	44	47	700	400	388	OH-58	CR	60	4	103
3	1	330	350	230	2000	1220	281	OH-58	CR	60	3	434
3	2	300	308	220	200	340	304	OH-58	CR	60	3	111
3	3	330	334	220	1000	1200	225	OH-58	CR	60	3	533
3	4	270	297	210	500	370	347	OH-58	CR	60	3	106
3	5	60	78	220	300	240	361	OH-58	CR	60	3	66
3	10	300	270	30	300	560	399	OH-58	CR	60	3	140
3	12	90	93	59	200	160	336	OH-58	CR	60	3	47
3	14	270	230	60	200	200	373	OH-58	CR	60	3	53
3	15	90	56	50	200	400	373	OH-58	CR	60	3	107
4	1	0	358	230	1000	1090	334	OH-58	CR	60	3	326
4	2	270	280	230	200	230	237	OH-58	CR	60	3	97
4	3	330	327	230	600	920	215	OH-58	CR	60	3	427
4	4	240	296	230	200	100	155	OH-58	CR	60	3	64
4	5	30	44	230	500	570	165	OH-58	CP	60	3	345
4	10	300	300	65	200	100	356	OH-58	CR	60	3	28
4	12	60	55	65	300	390	378	OH-58	CR	60	3	103
4	15	210	206	65	200	260	502	OH-58	CR	60	3	51
5	1	330	334	220	300	900	370	OH-58	CR	60	3	243
5	2	300	297	220	200	530	346	OH-58	CR	60	3	153
5	3	300	323	220	400	1050	258	OH-58	CR	60	3	406
5	5	0	348	220	700	620	361	OH-58	CR	60	3	171
5	10	330	331	40	300	340	449	OH-58	CR	60	3	75
5	12	60	61	55	9999	400	400	OH-58	CR	60	3	100
5	13	240	237	55	500	620	397	OH-58	CR	60	3	156
5	15	55	55	65	700	300	423	OH-58	CR	60	3	70

TABLE 30 (Continued)

FLIGHT DATA-SERIES 1

FLIGHT	TGT	ERB	PRB	HDG	ER	PR	AGL	ACFT	POS	AS	EXP	EAR
6	1	330	340	220	200	600	381	OH-58	CR	60	3	157
6	3	330	340	220	1000	1110	272	OH-58	CR	60	3	408
6	4	300	319	220	9999	400	381	OH-58	CR	60	3	104
6	5	45	20	220	500	450	405	OH-58	CR	60	3	111
6	6	330	348	215	200	500	513	OH-58	CR	60	3	97
6	10	330	319	35	150	450	432	OH-58	CR	60	3	104
6	12	91	99	42	300	220	311	OH-58	CR	60	3	70
6	15	45	49	50	300	280	392	OH-58	CR	60	3	71
7	1	300	345	220	1000	1140	347	OH-58	CR	60	4	328
7	2	90	56	220	300	420	326	OH-58	CR	60	4	128
7	3	330	314	220	1000	820	258	OH-58	CR	60	4	317
7	4	330	304	230	1000	840	288	OH-58	CR	60	4	291
7	5	0	335	220	300	350	375	OH-58	CR	60	4	93
7	7	270	357	205	1000	680	457	OH-58	CR	60	4	148
7	9	90	67	90	2000	1000	447	OH-58	CR	60	4	223
7	10	300	293	50	300	640	449	OH-58	CR	60	4	142
7	12	120	147	40	300	390	386	OH-58	CR	60	4	101
7	14	270	259	60	300	260	409	OH-58	CR	60	4	63
7	15	60	80	60	500	330	394	OH-58	CR	60	4	83
8	1	330	353	210	300	1140	395	OH-58	CR	60	8	288
8	2	300	324	210	200	400	336	OH-58	CR	60	8	119
8	3	345	346	210	500	1430	248	OH-58	CR	60	8	576
8	4	280	309	210	100	170	345	OH-58	CR	60	8	49
8	5	60	44	210	200	480	354	OH-58	CR	60	8	135
8	10	0	342	47	10	180	423	OH-58	CR	60	8	42
8	12	105	78	47	200	200	356	OH-58	CR	60	8	56
8	14	210	233	47	200	270	386	OH-58	CR	60	8	69
8	15	100	64	47	200	190	391	OH-58	CR	60	8	[illegible]
9	1	0	337	225	100	800	375	OH-58	CR	60	4	213
9	2	300	291	225	50	410	361	OH-58	CR	60	4	113
9	4	265	297	230	750	550	368	OH-58	CR	60	4	149
9	5	265	5	230	50	160	445	OH-58	CR	60	4	35
9	10	0	3	35	50	360	466	OH-58	CR	60	4	76
9	12	180	180	60	10	100	392	OH-58	CR	60	4	25
9	13	270	287	60	1000	950	362	OH-58	CR	60	4	262
9	14	270	269	65	50	500	425	OH-58	CR	60	4	117
10	1	330	350	220	400	1800	413	OH-58	CR	60	4	435
10	2	300	310	220	200	280	334	OH-58	CR	60	4	83
10	3	330	334	220	300	1060	220	OH-58	CR	60	4	481
10	4	270	270	220	300	200	264	OH-58	CR	60	4	75

TABLE 30 (Continued)

FLIGHT DATA-SERIES 1

FLIGHT	TGT	ERR	PRB	HDG	ER	PR	AGL	ACFT	POS	AS	EXP	EAR
10	6	0	349	220	60	200	413	OH-58	CR	60	4	48
10	10	330	335	50	100	316	395	OH-58	CR	60	4	80
10	12	90	62	50	200	330	329	OH-58	CR	60	4	100
10	15	60	52	55	400	300	367	OH-58	CR	60	4	81
11	1	330	336	225	500	610	311	OH-58	CR	60	3	196
11	2	330	306	225	9999	410	336	OH-58	CR	60	3	122
11	3	330	333	220	800	610	377	OH-58	CR	60	3	161
11	4	270	280	220	300	150	375	OH-58	CR	60	3	40
11	5	30	40	220	500	400	366	OH-58	CR	60	3	109
11	10	300	297	50	200	280	545	OH-58	CR	60	3	51
11	12	35	70	50	300	280	391	OH-58	CR	60	3	71
11	15	60	20	60	100	200	387	OH-58	CR	60	3	51
12	1	330	338	220	300	570	421	OH-58	CR	60	7	135
12	2	330	332	220	300	340	394	OH-58	CR	60	7	86
12	3	345	335	220	600	1400	222	OH-58	CR	60	7	630
12	5	30	40	220	300	510	366	OH-58	CR	60	7	139
12	6	90	65	220	200	80	391	OH-58	CR	60	7	20
12	10	300	300	55	200	330	459	OH-58	CR	60	7	71
12	15	330	15	40	100	220	445	OH-58	CR	60	7	49

TABLE 31

FLIGHT DATA-SERIES 2

FLIGHT	TGT	ERB	PRB	HDG	ER	PR	AGL	ACFT	POS	AS	EXP	EAR
1	1	300	330	218	300	700	400	OH-58	L	60	3	175
1	3	999	322	218	400	720	292	OH-58	L	60	3	246
1	5	90	57	218	200	200	372	OH-58	L	60	3	53
1	6	300	344	218	1500	450	490	OH-58	L	60	3	91
1	9	60	54	96	1200	1240	447	OH-58	L	60	3	277
2	1	300	337	218	200	620	171	OH-58	L	60	5	362
2	3	300	333	218	500	1080	247	OH-58	L	60	5	437
2	5	30	43	218	200	330	359	OH-58	L	60	5	91
3	1	999	16	218	9999	250	250	OH-58	L	65	3	100
3	2	270	230	218	200	300	306	OH-58	L	65	3	98
3	3	330	326	218	1000	770	262	OH-58	L	65	3	293
3	4	270	298	218	800	370	343	OH-58	L	65	3	107
3	5	30	21	230	500	330	392	OH-58	L	65	3	84
4	1	300	328	220	200	550	352	OH-58	L	65	3	156
4	2	240	207	225	200	510	312	OH-58	L	60	3	163
4	4	270	275	225	200	280	356	OH-58	L	60	3	78
4	5	30	21	230	250	400	363	OH-58	L	65	3	110
4	6	300	340	210	75	200	412	OH-58	L	65	3	48
4	9	90	101	50	700	1130	447	OH-58	L	65	3	252
4	10	260	230	55	250	250	498	OH-58	L	65	3	50
4	12	90	78	55	100	100	361	OH-58	L	60	3	27
4	15	0	0	55	10	50	423	OH-58	L	60	3	11
5	1	300	328	225	300	680	312	OH-58	L	60	3	217
5	2	330	295	225	300	260	312	OH-58	L	60	3	83
5	3	300	306	225	200	500	206	OH-58	L	60	3	242
5	4	270	296	225	100	240	335	OH-58	L	60	3	71
5	5	60	38	225	100	300	323	OH-58	L	62	3	92
5	7	0	348	225	1000	1600	414	OH-58	L	60	3	386
5	14	90	136	50	150	370	411	OH-58	L	60	3	90
5	15	30	16	60	100	360	399	OH-58	L	60	3	90
6	1	300	304	225	500	660	310	OH-58	L	65	10	212
6	2	300	277	225	700	370	308	OH-58	L	65	10	120
6	4	270	293	230	600	330	326	OH-58	L	60	10	101
6	5	30	23	230	600	380	344	OH-58	L	65	10	110
6	6	270	342	215	50	100	386	OH-58	L	65	10	25
6	7	0	342	215	2500	1250	424	OH-58	L	60	10	294
6	9	90	95	60	3000	1230	493	OH-58	L	60	10	249
6	10	270	255	60	300	250	519	OH-58	L	60	10	48
6	14	280	252	50	800	420	428	OH-58	L	60	10	98
6	15	0	31	50	10	40	416	OH-58	L	60	10	9

TABLE 31 (Continued)

FLIGHT DATA-SERIES 2

FLIGHT	TGT	ERB	PRB	HDG	ER	PR	AGL	ACFT	POS	AS	EXP	EAR
7	1	330	326	220	300	720	332	OH-58	L	65	6	216
7	3	330	303	220	500	570	169	OH-58	L	65	6	301
7	5	60	18	220	400	640	330	OH-58	L	65	6	193
8	1	300	317	218	500	520	37[illegible]	OH-58	L	65	5	140
8	3	300	331	218	1500	1050	[illegible]	OH-58	L	63	5	441
8	5	30	22	218	2500	640	[illegible]35	OH-58	L	68	5	166
8	9	60	51	96	1500	1290	469	OH-58	L	68	5	275
9	1	300	343	225	300	650	422	OH-58	L	70	3	154
9	2	300	311	225	500	600	402	OH-58	L	70	3	149
9	3	330	343	225	1000	1430	323	OH-58	L	70	3	442
9	4	270	253	225	400	350	335	OH-58	L	79	3	104
9	5	60	28	230	900	370	371	OH-58	L	70	3	99
9	10	270	270	80	300	240	539	OH-58	L	65	3	44
9	15	0	16	55	700	420	455	OH-58	L	60	3	92
10	1	330	331	218	500	840	375	OH-58	L	65	3	224
10	2	345	317	218	900	530	401	OH-58	L	65	3	132
10	3	332	336	218	2000	1220	298	OH-58	L	60	3	409
10	4	210	267	218	2500	350	385	OH-58	L	60	3	90
10	5	85	14	218	1000	460	392	OH-58	L	60	3	117
11	1	270	287	230	1000	560	372	OH-58	L	65	2	150
11	2	300	288	230	1000	250	328	OH-58	L	65	2	76
11	3	300	318	230	1000	540	298	OH-58	L	65	2	161
11	4	330	275	230	1200	300	381	OH-58	L	65	2	78
11	5	90	85	230	1000	210	403	OH-58	L	65	2	52
11	6	0	337	230	10	220	505	OH-58	L	65	2	43
11	10	330	297	55	300	230	527	OH-58	L	65	2	43
12	1	270	303	215	200	200	307	OH-58	L	68	2	65
12	2	270	234	215	200	260	303	OH-58	L	68	2	85
12	3	270	263	215	200	430	326	OH-58	L	68	2	131
12	4	270	284	225	100	260	343	OH-58	L	68	2	75
12	5	330	45	220	75	180	341	OH-58	L	65	2	52
12	6	300	350	220	10	320	473	OH-58	L	62	2	67
12	7	60	60	70	300	1000	504	OH-58	L	60	2	198
12	9	90	91	70	300	1250	517	OH-58	L	60	2	241
12	10	270	332	79	10	380	500	OH-58	L	70	2	76
12	12	0	79	72	10	90	421	OH-58	L	64	2	21

TABLE 32

FLIGHT DATA-SERIES 3

FLIGHT	TGT	ERB	PRB	HDG	ER	PR	AGL	ACFT	POS	AS	EXP	EAP
1	N10	270	294	51	500	500	132	OH-58	L	60	3	379
1	N16	30	26	48	100	520	180	OH-58	L	60	3	289
1	N11	270	280	48	10	90	110	OH-58	L	60	3	82
1	N27	0	4	48	50	295	190	OH-58	L	60	3	155
1	N23	30	31	48	500	785	150	OH-58	L	60	3	523
1	N13	360	358	48	9999	260	160	OH-58	L	60	3	163
1	N15	90	59	48	9999	280	190	OH-58	L	60	3	147
1	N12	0	0	38	10	441	150	OH-58	L	60	3	294
1	N22	270	291	38	500	380	140	OH-58	L	60	3	271
1	S 3	90	105	228	500	595	230	OH-58	L	60	3	259
1	S10	270	269	231	100	510	270	OH-58	L	60	3	189
1	S 7	0	2	231	5 0	580	230	OH-58	L	60	3	252
1	S 6	60	39	231	500	945	220	OH-58	L	60	3	430
1	S 1	60	49	230	1500	1475	250	OH-58	L	60	3	590
1	N 1	30	19	33	10	480	250	OH-58	L	65	3	192
1	N24	0	13	45	500	302	170	OH-58	L	65	3	178
1	N 4	30	26	45	1000	705	160	OH-58	L	65	3	441
1	N26	330	326	45	1000	855	210	OH-58	L	65	3	407
1	N 6	90	86	45	500	680	270	OH-58	L	65	3	252
1	N 3	90	82	42	1000	903	350	OH-58	L	65	3	258
7	N10	300	312	52	500	580	80	OH-58	L	60	6	725
7	N11	0	2	51	10	160	140	OH-58	L	60	6	114
7	N16	60	57	51	200	280	120	OH-58	L	60	6	233
7	N27	0	20	51	10	190	120	OH-58	L	60	6	158
7	N13	330	350	37	10	190	120	OH-58	L	60	6	158
7	N14	330	350	37	10	190	120	OH-58	L	60	6	158
7	N23	90	72	37	400	440	120	OH-58	L	60	6	367
7	N15	90	115	37	300	250	110	OH-58	L	60	6	227
7	N12	330	356	37	200	260	130	OH-58	L	60	6	200
7	N22	270	268	37	9999	425	150	OH-58	L	60	6	283
7	S19	999	291	237	9999	1130	190	OH-58	L	60	6	595
7	S27	999	291	237	9999	1130	190	OH-58	L	60	6	595
7	S 3	60	46	223	600	820	200	OH-58	L	60	6	410
7	S 7	90	10	228	400	370	140	OH-58	L	60	6	264
7	S 4	90	68	231	800	1160	120	OH-58	L	60	6	967
7	N 1	0	13	55	400	560	230	OH-58	L	60	6	243
7	N24	30	14	49	200	380	90	OH-58	L	60	6	422
7	N26	300	323	50	500	820	210	OH-58	L	60	6	390
7	N 3	90	75	42	600	915	260	OH-58	L	60	6	352
7	N 4	60	48	48	200	460	240	OH-58	L	60	6	192

TABLE 32(CONTINUED)

FLIGHT DATA-SERIES 3

FLIGHT	TGT	ERB	PRB	HDG	ER	FR	AGL	ACFT	POS	AS	EXP	EAR
27	N17	105	41	47	800	580	110	OH-58	L	60	0	527
27	N11	270	312	47	300	230	90	OH-58	L	60	0	256
27	N16	0	9	47	000	220	90	OH-58	L	60	0	244
27	N19	300	325	47	200	280	90	OH-58	L	60	0	311
27	N27	300	325	47	200	280	90	OH-58	L	60	0	311
27	N15	0	5	51	000	200	120	OH-58	L	60	0	167
27	N23	30	40	51	50	310	140	OH-58	L	60	0	221
27	N12	285	325	28	75	310	120	OH-58	L	60	0	258
27	S22	270	293	45	100	480	120	OH-58	L	60	0	400
27	S 9	285	338	45	100	550	300	OH-58	L	60	0	183
27	S 7	15	19	224	175	660	510	OH-58	L	60	0	129
27	S 5	60	53	233	300	1000	330	OH-58	L	60	0	303
27	N 1	0	350	72	150	600	220	OH-58	L	60	0	273
27	N24	330	338	50	100	260	160	OH-58	L	60	0	163
27	N 5	60	61	50	400	550	100	OH-58	L	60	0	550
27	N 6	30	37	50	150	700	120	OH-58	L	60	0	583
27	N26	300	308	50	500	870	190	OH-58	L	60	0	458
27	N 3	75	61	52	300	780	160	OH-58	L	60	0	438
2	N10	330	282	51	500	495	130	AH-1	F	60	2	381
2	N11	330	306	40	100	85	110	AH-1	F	60	2	77
2	N16	90	60	40	9999	230	125	AH-1	F	60	2	184
2	N27	0	8	40	9999	130	90	AH-1	F	60	2	144
2	N23	60	65	46	1000	460	90	AH-1	F	60	2	511
2	N13	270	234	46	100	90	90	AH-1	F	60	2	100
2	N15	90	120	46	100	220	70	AH-1	F	60	2	314
2	N22	270	262	46	9999	460	150	AH-1	F	60	2	307
2	N12	270	270	38	9999	120	150	AH-1	F	60	2	80
2	S10	300	288	234	500	610	120	AH-1	F	65	2	508
2	S 7	270	310	230	10	105	90	AH-1	F	65	2	117
2	S 1	270	76	227	2000	1120	160	AH-1	F	65	2	700
2	N 1	30	30	48	9999	660	290	AH-1	F	60	2	228
2	N24	360	354	50	500	400	210	AH-1	F	60	2	190
2	N 5	90	101	58	500	540	240	AH-1	F	60	2	225
2	N 6	30	30	52	1000	350	250	AH-1	F	60	2	380
2	N26	270	277	58	1000	730	120	AH-1	F	60	2	608
2	N19	0	8	40	9999	130	90	AH-1	F	60	2	144
2	N 3	60	62	45	1000	710	160	AH-1	F	60	2	444
3	N17	90	72	29	9999	195	90	AH-1	F	67	2	217
3	N16	330	345	29	500	500	50	AH-1	F	67	2	1000
3	N19	300	330	29	9999	410	80	AH-1	F	67	2	513

TABLE 32 (CONTINUED)

FLIGHT DATA-SERIES 3

FLIGHT	TGT	ERB	PRB	HDG	ER	PR	AGL	ACFT	POS	AS	EXP	EAR
3	N27	300	330	29	9999	410	80	AH-1	F	67	2	513
3	N15	0	11	29	10	160	170	AH-1	F	67	2	94
3	N23	90	80	29	9999	220	120	AH-1	F	67	2	183
3	N12	300	320	61	9999	200	100	AH-1	F	67	2	200
3	S 3	90	105	220	9999	490	300	AH-1	F	55	2	163
3	S 7	90	65	216	9999	260	150	AH-1	F	55	2	173
3	N 1	0	24	65	9999	730	100	AH-1	F	70	2	730
3	N24	360	354	52	9999	495	120	AH-1	F	70	2	413
3	N 4	30	30	38	9999	560	120	AH-1	F	70	2	467
3	N 2	300	314	29	9999	540	130	AH-1	F	70	2	415
3	N26	270	283	29	9999	375	50	AH-1	F	70	2	750
5	N11	270	335	45	200	160	110	AH-1	R	65	3	145
5	N16	60	40	45	100	280	110	AH-1	R	65	3	255
5	N19	0	5	45	200	220	90	AH-1	R	65	3	244
5	N27	0	5	45	200	220	90	AH-1	R	65	3	244
5	N14	360	349	45	200	300	110	AH-1	R	65	3	273
5	N12	270	321	35	100	80	90	AH-1	R	65	3	89
5	S 3	60	50	222	500	720	120	AH-1	R	60	3	600
5	S 6	90	65	228	500	740	200	AH-1	R	60	3	370
5	N 1	30	10	55	400	660	100	AH-1	R	60	3	660
5	N24	0	2	50	600	1130	210	AH-1	R	60	3	538
5	N 4	30	16	48	500	780	180	AH-1	R	60	3	433
5	N26	300	312	46	600	855	130	AH-1	R	60	3	658
5	N 6	90	76	55	400	550	110	AH-1	R	60	3	500
5	N 3	90	74	37	800	820	170	AH-1	R	60	3	482
6	N11	30	0	43	100	160	130	AH-1	F	65	5	123
6	N16	60	60	47	300	280	90	AH-1	F	65	5	311
6	N27	30	14	49	100	200	90	AH-1	F	65	5	222
6	N14	0	0	49	200	260	110	AH-1	F	65	5	236
6	N13	0	0	49	100	70	90	AH-1	F	65	5	79
6	N22	300	294	54	500	440	100	AH-1	F	65	5	440
6	N12	300	310	38	200	75	150	AH-1	F	65	5	50
6	S 9	300	316	220	200	260	250	AH-1	F	70	5	104
6	S10	270	301	216	500	280	250	AH-1	F	70	5	112
6	S 8	300	315	215	300	230	260	AH-1	F	70	5	89
6	S 7	60	69	224	600	430	250	AH-1	F	70	5	172
6	N 1	30	24	45	800	660	140	AH-1	F	70	5	471
6	N24	0	7	48	800	490	250	AH-1	F	70	5	196
6	N 4	30	23	46	900	935	110	AH-1	F	70	5	850
6	N 6	60	52	41	1000	945	190	AH-1	F	70	5	497

TABLE 32(CONTINUED)

FLIGHT DATA-SERIES 3

FLIGHT	TGT	ERB	PRB	HDG	ER	PR	AGL	ACFT	POS	AS	EXP	EAR
6	N26	300	334	33	900	640	210	AH-1	F	70	5	305
6	N 3	999	132	51	9999	1330	410	AH-1	F	70	5	324
8	N16	60	33	46	300	360	80	AH-1	R	65	8	450
8	N19	360	355	46	100	250	80	AH-1	R	65	8	313
8	N27	360	355	46	100	250	80	AH-1	R	65	8	313
8	N22	300	328	46	800	780	100	AH-1	R	65	8	780
8	N14	270	245	46	50	50	100	AH-1	R	65	8	50
8	N12	300	297	33	50	100	100	AH-1	R	65	8	100
8	S 3	60	50	225	200	467	100	AH-1	R	70	8	467
8	S 4	60	50	225	300	567	100	AH-1	R	70	8	567
8	S24	90	55	235	9999	690	100	AH-1	R	70	8	690
8	N 1	60	34	30	200	590	200	AH-1	R	70	8	295
8	N24	360	355	85	2000	1250	280	AH-1	R	70	8	446
8	N 5	60	58	50	600	730	200	AH-1	R	70	8	365
8	N26	300	319	49	1000	945	80	AH-1	R	70	8	1181
8	N 6	60	51	55	600	680	170	AH-1	R	70	8	400
8	N 3	90	70	44	600	700	230	AH-1	R	70	8	304
25	N16	30	38	48	100	460	60	AH-1	F	65	0	767
25	N11	270	270	48	9999	60	60	AH-1	F	65	0	100
25	N19	30	8	48	200	250	60	AH-1	F	65	0	417
25	N27	30	8	48	200	250	60	AH-1	F	65	0	417
25	N15	60	71	40	100	250	60	AH-1	F	65	0	417
25	N23	60	93	40	500	425	60	AH-1	F	65	0	708
25	N12	300	344	40	200	105	60	AH-1	F	65	0	175
25	S 3	60	48	213	1000	750	110	AH-1	F	70	0	682
25	N 6	30	33	42	1500	1410	280	AH-1	F	65	0	504
25	N 4	60	35	42	2000	760	160	AH-1	F	65	0	475
25	N24	90	101	40	100	150	200	AH-1	F	65	0	75
25	N26	330	335	40	500	650	240	AH-1	F	65	0	271
25	N 3	60	66	45	1500	1010	180	AH-1	F	65	0	561
19	N10	270	243	62	9999	740	320	OH-58	L	60	3	231
19	N16	0	354	47	9999	520	270	OH-58	L	60	3	193
19	N17	30	52	47	9999	360	280	OH-58	L	60	3	129
19	N11	270	271	47	9999	310	260	OH-58	L	60	3	119
19	N19	270	304	47	9999	240	260	OH-58	L	60	3	92
19	N27	270	304	47	9999	240	260	OH-58	L	60	3	92
19	N23	15	23	47	9999	330	350	OH-58	L	60	3	94
19	N15	270	250	41	9999	60	310	OH-58	L	60	3	19
19	N12	270	295	27	9999	190	340	OH-58	L	60	3	56
19	S22	270	275	220	9999	330	190	OH-58	L	65	3	174

TABLE 32(CONTINUED)

FLIGHT DATA-SERIES 3

FLIGHT	TGT	ERB	PRB	HDG	ER	PR	AGL	ACFT	POS	AS	EXP	EAR
19	S27	270	289	215	9999	890	230	OH-58	L	65	3	387
19	S 3	30	62	215	9999	1140	460	OH-58	L	65	3	248
19	S 9	0	350	238	9999	480	440	OH-58	L	65	3	109
19	S10	15	329	238	9999	450	710	OH-58	L	65	3	63
19	S 8	90	47	236	9999	430	650	OH-58	L	65	3	66
19	S 7	30	40	236	9999	330	540	OH-58	L	65	3	61
19	S 1	30	38	238	9999	1770	450	OH-58	L	65	3	393
19	N 1	0	7	53	9999	550	550	OH-58	L	55	3	100
19	N24	330	338	58	9999	510	600	OH-58	L	55	3	85
19	N 4	0	350	58	9999	620	460	OH-58	L	55	3	135
19	N 6	45	88	58	9999	250	340	OH-58	L	55	3	74
19	N26	270	267	58	9999	915	410	OH-58	L	55	3	223
19	N 3	30	20	40	9999	890	380	OH-58	L	55	3	234
16	N10	300	298	46	500	510	210	OH-58	L	60	9	243
16	N16	15	20	46	2500	1060	340	OH-58	L	60	9	312
16	N17	30	62	46	500	660	200	OH-58	L	60	9	330
16	N11	0	10	46	9999	100	140	OH-58	L	60	9	71
16	N19	15	9	46	500	400	140	OH-58	L	60	9	286
16	N27	15	9	46	500	400	140	OH-58	L	60	9	286
16	N13	360	360	46	10	150	160	OH-58	L	60	9	94
16	N14	360	360	46	10	150	160	OH-58	L	60	9	94
16	N12	360	330	41	100	210	140	OH-58	L	60	9	150
16	N22	220	251	39	500	310	220	OH-58	L	60	9	141
16	S22	330	339	237	500	360	340	OH-58	L	50	9	106
16	S 3	90	63	226	500	690	210	OH-58	L	50	9	329
16	S 9	270	300	229	500	340	400	OH-58	L	50	9	85
16	S 8	300	316	228	1000	700	370	OH-58	L	50	9	189
16	S 4	90	58	230	1200	1300	280	OH-58	L	50	9	464
16	S 7	0	25	230	9999	190	210	OH-58	L	50	9	90
16	N 4	15	14	49	2000	1830	210	OH-58	L	60	9	871
16	N24	0	1	49	1500	810	260	OH-58	L	60	9	312
16	N 2	300	330	49	2000	1060	210	OH-58	L	60	9	505
16	N 3	90	58	42	1500	1035	250	OH-58	L	60	9	414
12	N11	90	0	50	10	150	180	OH-58	L	50	5	83
12	N19	30	4	50	500	260	110	OH-58	L	50	5	236
12	N27	30	4	50	500	260	110	OH-58	L	50	5	236
12	N13	360	360	44	10	100	120	OH-58	L	50	5	83
12	N23	90	80	44	200	430	80	OH-58	L	50	5	538
12	N12	300	354	44	200	270	160	OH-58	L	50	5	169
12	N22	300	275	44	500	370	160	OH-58	L	50	5	231

TABLE 32(CONTINUED)

FLIGHT DATA-SERIES 3

FLIGHT	TGT	ERB	PRB	HDG	ER	PR	AGL	ACFT	POS	AS	EXP	EAR
12	S22	300	323	232	200	430	200	OH-56	L	60	5	215
12	S 3	60	47	226	300	890	150	OH-58	L	60	5	593
12	S 9	270	263	230	200	370	250	OH-58	L	60	5	148
12	S 6	6[illegible]	45	228	300	1020	210	OH-58	L	60	5	486
12	S 7	30	20	228	50	220	160	OH-58	L	60	5	138
12	N 1	0	10	57	200	670	280	OH-58	L	60	5	239
12	N24	0	6	57	1000	1470	260	OH-58	L	60	5	565
12	N 4	15	16	47	500	845	250	OH-58	L	60	5	338
12	N26	330	321	47	500	845	200	OH-58	L	60	5	423
12	N 3	60	54	47	1000	1060	80	OH-58	L	60	5	1325
30	N10	300	322	50	300	620	220	OH-58	L	60	7	282
30	N27	360	360	50	10	580	170	OH-58	L	60	7	341
30	N11	270	330	50	100	110	190	OH-58	L	60	7	58
30	N16	60	55	50	300	240	170	OH-58	L	60	7	141
30	N17	90	112	50	500	560	150	OH-58	L	60	7	373
30	N13	348	352	38	400	280	160	OH-58	L	60	7	175
30	N14	348	352	38	400	280	160	OH-58	L	60	7	175
30	N15	60	92	38	400	250	100	OH-58	L	60	7	250
30	N23	60	72	38	400	460	100	OH-58	L	60	7	460
30	N22	300	305	38	400	420	100	OH-58	L	60	7	420
30	N12	345	357	38	400	250	130	OH-58	L	60	7	192
30	S22	300	333	230	400	340	210	OH-58	L	50	7	162
30	S 3	30	42	226	600	935	130	OH-58	L	50	7	719
30	S 7	0	4	227	410	640	170	OH-58	L	50	7	376
30	S 4	60	53	227	1000	1330	170	OH-58	L	50	7	782
30	S 1	60	63	220	800	1280	130	OH-58	L	50	7	985
30	N 1	15	12	55	600	550	190	OH-58	L	60	7	289
30	N24	360	360	55	1350	1400	220	OH-58	L	60	7	636
30	N 4	15	15	46	900	945	220	OH-58	L	60	7	430
30	N 6	15	35	46	600	930	100	OH-58	L	60	7	930
30	N26	345	313	46	800	880	160	OH-58	L	60	7	510
30	N 3	75	66	42	800	1000	140	OH-58	L	60	7	714
22	N11	330	330	45	1500	153	190	AH-1	R	60	3	81
22	N27	330	7	45	300	310	170	AH-1	R	60	3	182
22	N13	999	9	45	490	200	180	AH-1	R	60	3	111
22	N16	999	135	45	500	280	140	AH-1	R	60	3	200
22	N14	270	353	45	800	150	150	AH-1	R	60	3	100
22	N22	330	303	45	1500	500	120	AH-1	R	60	3	417
22	N12	999	319	45	50	100	100	AH-1	R	60	3	100
22	S13	330	313	227	1500	820	200	AH-1	R	65	3	410

TABLE 32(CONTINUED)

FLIGHT DATA-SERIES 3

FLIGHT	TGT	ERB	PRB	HDG	ER	PR	AGL	ACFT	POS	HS	EXP	EAP
22	S19	60	64	237	2000	950	150	AH-1	R	65	3	673
22	S16	330	272	233	1500	1040	370	AH-1	R	65	3	281
22	S 9	300	347	230	1000	1600	250	AH-1	R	65	3	640
22	S 3	60	32	230	1500	900	280	AH-1	R	65	3	321
22	S 4	75	34	230	3000	180C	340	AH-1	R	65	3	529
22	S 7	30	5	230	10	400	200	AH-1	R	65	3	200
22	S 6	60	55	230	1000	855	250	AH-1	R	65	3	742
22	N 1	60	18	47	1200	560	300	AH-1	R	65	3	187
22	N24	30	12	42	2000	750	320	AH-1	R	65	3	234
22	N 6	60	32	46	3000	1350	300	AH-1	R	65	3	450
22	N 4	330	23	46	3000	880	270	AH-1	R	65	3	326
22	N 4	270	302	52	2000	550	300	AH-1	R	65	3	183
21	N10	300	295	61	200	590	330	AH-1	F	60	1	179
21	N16	60	52	45	100	320	200	AH-1	F	60	1	160
21	N27	30	27	47	50	190	200	AH-1	F	60	1	95
21	N19	30	52	47	50	120	180	AH-1	F	60	1	67
21	N13	360	360	47	200	250	160	AH-1	F	60	1	156
21	N22	330	320	41	500	580	160	AH-1	F	60	1	363
21	N23	90	100	41	1200	470	170	AH-1	F	60	1	276
21	N12	360	360	41	50	75	130	AH-1	F	60	1	58
21	S 3	60	53	215	500	950	300	AH-1	F	65	1	31
21	S 9	320	330	215	100	320	300	AH-1	F	65	1	137
21	S 8	330	317	222	100	230	380	AH-1	F	65	1	61
21	S 1	60	88	231	800	1280	480	AH-1	F	65	1	267
21	N 1	30	18	53	200	655	380	AH-1	F	65	1	172
21	N24	0	2	53	800	1360	340	AH-1	F	65	1	400
21	N 4	0	10	53	1000	1400	360	AH-1	F	65	1	389
21	N26	30	46	35	300	700	410	AH-1	F	65	1	171
20	N10	330	297	45	9999	550	280	AH-1	F	65	11	196
20	N16	90	25	45	9999	400	210	AH-1	F	65	11	190
20	N11	270	335	45	9999	100	190	AH-1	F	65	11	53
20	N19	360	360	45	9999	240	210	AH-1	F	65	11	114
20	N27	360	360	45	9999	240	210	AH-1	F	65	11	114
20	N17	90	86	45	9999	490	220	AH-1	F	65	11	223
20	N15	90	61	40	9999	300	230	AH-1	F	65	11	130
20	N23	55	60	40	9999	480	220	AH-1	F	65	11	219
20	N13	270	260	40	9999	65	260	AH-1	F	65	11	25
20	N14	270	250	40	9999	60	280	AH-1	F	65	11	21
20	N22	299	270	40	9999	490	270	AH-1	F	65	11	181
20	N12	270	270	40	9999	80	320	AH-1	F	65	11	25

TABLE 32(CONTINUED)

FLIGHT DATA-SERIES 3

FLIGHT	TGT	ERB	PRB	HDG	ER	PR	AGL	ACFT	POS	AS	EXP	EAR
20	S22	270	305	226	9999	460	220	AH-1	F	65	11	209
20	S 3	60	37	226	1500	1100	240	AH-1	F	65	11	458
20	S 9	300	330	228	900	650	250	AH-1	F	65	11	260
20	S 7	0	10	230	400	430	290	AH-1	F	65	11	148
20	S 4	75	70	234	1600	1100	370	AH-1	F	65	11	297
20	S 1	90	77	229	800	1000	480	AH-1	F	65	11	208
20	N 1	30	27	49	500	460	390	AH-1	F	65	11	118
20	N 4	30	18	46	1700	1340	390	AH-1	F	65	11	344
20	N24	0	13	46	700	580	360	AH-1	F	65	11	161
20	N26	270	265	46	800	450	300	AH-1	F	65	11	150
20	N 2	270	265	46	800	450	300	AH-1	F	65	11	150
20	N 3	65	70	48	2500	950	320	AH-1	F	65	11	297
18	N10	270	260	47	150	510	280	AH-1	F	65	6	182
18	N16	15	13	43	150	580	200	AH-1	F	65	6	290
18	N19	0	2	48	150	630	140	AH-1	F	65	6	450
18	N27	0	2	48	150	630	140	AH-1	F	65	6	450
18	N11	270	289	48	50	80	140	AH-1	F	65	6	57
18	N14	360	345	48	50	380	200	AH-1	F	65	6	190
18	N13	360	345	48	50	220	170	AH-1	F	65	6	129
18	N22	270	272	39	9999	480	140	AH-1	F	65	6	343
18	N12	270	294	39	9999	150	130	AH-1	F	65	6	115
18	S22	270	233	211	250	690	280	AH-1	F	60	6	246
18	S 9	345	300	216	150	580	200	AH-1	F	60	6	290
18	S10	300	285	223	100	250	270	AH-1	F	60	6	93
18	S 8	999	329	223	9999	410	260	AH-1	F	60	6	158
18	N 1	0	9	50	150	550	360	AH-1	F	60	6	153
18	N24	360	353	57	250	1100	430	AH-1	F	60	6	256
18	N26	300	324	38	200	720	360	AH-1	F	60	6	200
18	N 4	120	97	48	9999	360	280	AH-1	F	60	6	129
18	N 3	75	53	51	500	1050	290	AH-1	F	60	6	362
15	N10	60	76	46	2000	780	480	AH-1	F	65	6	163
15	N16	30	18	44	700	540	200	AH-1	F	65	6	270
15	N11	300	323	44	400	184	130	AH-1	F	65	6	142
15	N19	0	5	44	400	400	130	AH-1	F	65	6	308
15	N27	0	5	44	400	400	130	AH-1	F	65	6	308
15	N15	30	39	45	600	290	170	AH-1	F	65	6	171
15	N13	270	275	45	300	75	160	AH-1	F	65	6	47
15	N14	270	250	45	100	75	160	AH-1	F	65	6	47
15	N12	330	335	38	200	140	150	AH-1	F	65	6	93
15	S 3	90	73	216	800	1130	340	AH-1	F	70	6	332

TABLE 32(CONTINUED)

FLIGHT DATA-SERIES 3

FLIGHT	TGT	ERB	PRB	HDG	ER	PR	AGL	ACFT	POS	AS	EXP	EAR
15	S10	270	240	238	200	60	480	AH-1	F	70	6	13
15	S 8	270	335	238	200	330	380	AH-1	F	70	6	87
15	S 7	60	43	238	1200	590	350	AH-1	F	70	6	169
15	S 4	90	73	238	1500	1410	300	AH-1	F	70	6	470
15	N 1	30	23	339	800	640	370	AH-1	F	70	6	173
15	N24	0	3	45	1200	820	380	AH-1	F	70	6	216
15	N 4	30	17	45	1800	1210	400	AH-1	F	70	6	303
15	N26	330	326	45	1200	780	370	AH-1	F	70	6	211
15	N 2	270	318	32	1000	410	370	AH-1	F	70	6	111
15	N 3	90	59	53	1500	915	310	AH-1	F	70	6	295
14	N10	270	272	48	400	540	250	AH-1	R	60	10	216
14	N11	270	303	44	200	120	140	AH-1	R	60	10	86
14	N19	0	30	44	100	150	140	AH-1	R	60	10	107
14	N27	0	30	44	100	150	140	AH-1	R	60	10	107
14	N17	150	140	44	600	740	140	AH-1	R	60	10	529
14	N23	90	74	44	200	400	100	AH-1	R	60	10	400
14	N22	90	268	38	400	440	80	AH-1	R	60	10	550
14	N12	360	263	38	100	100	80	AH-1	R	60	10	125
14	S22	300	328	232	600	700	160	AH-1	R	60	10	438
14	S 9	300	333	229	600	620	120	AH-1	R	60	10	517
14	S 3	90	89	229	600	630	300	AH-1	R	60	10	210
14	S 7	0	23	230	0	290	300	AH-1	R	60	10	97
14	S 6	90	97	230	800	750	150	AH-1	R	60	10	500
14	N 1	30	11	55	300	590	250	AH-1	R	60	10	236
14	N24	360	355	49	400	490	250	AH-1	R	60	10	196
14	N 4	60	16	49	700	915	200	AH-1	R	60	10	458
14	N26	300	312	49	500	820	180	AH-1	R	60	10	456
14	N 3	60	44	48	700	950	280	AH-1	R	60	10	339
4	N 8	270	228	52	1000	640	210	AH-1	F	65	5	305
4	N10	270	258	52	500	540	230	AH-1	F	65	5	235
4	N17	60	42	45	800	690	150	AH-1	F	65	5	460
4	N16	30	17	45	400	540	150	AH-1	F	65	5	360
4	N11	300	337	45	200	250	160	AH-1	F	65	5	156
4	N19	360	360	45	300	460	140	AH-1	F	65	5	329
4	N27	360	360	45	300	460	140	AH-1	F	65	5	329
4	N13	360	343	45	300	270	140	AH-1	F	65	5	193
4	N14	360	343	45	300	270	140	AH-1	F	65	5	193
4	N15	60	42	45	300	260	130	AH-1	F	65	5	200
4	N23	60	68	36	300	400	120	AH-1	F	65	5	333
4	N22	270	282	42	300	460	120	AH-1	F	65	5	383

TABLE 72(CONTINUED)

FLIGHT DATA-SERIES 3

FLIGHT	TGT	ERB	PRB	HDG	ER	FR	AGL	ACFT	POS	AS	EXP	EAR
4	N12	300	313	42	100	150	130	AH-1	F	65	5	115
4	S 9	330	343	228	300	900	230	AH-1	F	65	5	391
4	S 3	90	96	226	300	700	310	AH-1	F	65	5	226
4	S 7	30	18	230	200	510	200	AH-1	F	65	5	255
4	S 1	90	83	231	500	1150	170	AH-1	F	65	5	676
4	N 1	30	11	47	800	600	300	AH-1	F	65	5	200
4	N24	30	356	45	300	780	250	AH-1	F	65	5	312
4	N 4	30	11	48	500	1040	250	AH-1	F	65	5	416
4	N 6	300	45	47	400	850	200	AH-1	F	65	5	425
4	N 7	90	60	47	1000	1410	230	AH-1	F	65	5	613
4	N26	270	293	47	600	590	230	AH-1	F	65	5	257
4	N 3	90	51	47	600	960	240	AH-1	F	65	5	400
31	N11	270	325	43	100	160	140	AH-1	R	65	13	114
31	N16	60	44	43	150	250	230	AH-1	R	65	13	109
31	N19	360	360	43	300	290	220	AH-1	R	65	13	132
31	N27	360	360	43	300	290	220	AH-1	R	65	13	132
31	N15	60	54	45	200	250	250	AH-1	R	65	13	100
31	N13	270	230	45	100	75	230	AH-1	R	65	13	33
31	N14	270	230	45	100	75	230	AH-1	R	65	13	33
31	N23	90	81	45	200	380	200	AH-1	R	65	13	190
31	N12	270	303	40	100	125	220	AH-1	R	65	13	57
31	S 9	300	335	211	100	640	370	AH-1	R	70	13	173
31	S10	270	320	216	100	490	560	AH-1	R	70	13	88
31	S 8	300	337	214	300	540	570	AH-1	R	70	13	95
31	S 7	90	59	223	200	430	400	AH-1	R	70	13	108
31	N 1	30	11	63	200	520	270	AH-1	R	65	13	193
31	N24	30	0	48	200	360	300	AH-1	R	65	13	120
31	N 4	60	43	32	250	640	280	AH-1	R	65	13	229
31	N 6	90	70	32	300	850	300	AH-1	R	65	13	283
31	N26	210	233	57	250	440	150	AH-1	R	65	13	293
31	N 2	210	233	57	250	440	150	AH-1	R	65	13	293
31	N 3	90	84	58	350	790	500	AH-1	R	65	13	158
29	N10	270	279	45	500	540	140	AH-1	R	60	5	336
29	N17	30	56	45	500	600	70	AH-1	R	60	5	857
29	N11	999	118	45	9999	100	100	AH-1	R	60	5	100
29	N19	360	360	45	200	200	100	AH-1	R	60	5	200
29	N27	360	360	45	200	200	100	AH-1	R	60	5	200
29	N16	90	61	45	400	200	100	AH-1	R	60	5	200
29	N13	270	290	45	150	120	110	AH-1	R	60	5	109
29	N14	270	290	45	150	120	110	AH-1	R	60	5	109

TABLE 32 (CONTINUED)

FLIGHT DATA-SERIES 3

FLIGHT	TGT	ERB	PRB	HDG	ER	FR	AGL	ACFT	POS	HS	EXP	EXP
29	N23	60	80	45	400	210	120	AH-1	F	60	5	175
29	N22	270	271	36	200	450	100	AH-1	F	60	5	450
29	N12	270	256	36	50	110	110	AH-1	F	60	5	100
29	S22	270	314	228	200	400	110	AH-1	F	65	5	364
29	S11	270	265	229	400	730	100	AH-1	F	65	5	730
29	S 9	330	341	228	500	760	80	AH-1	F	65	5	950
29	S 3	90	61	230	600	760	90	AH-1	F	65	5	344
29	S 7	90	22	232	50	380	100	AH-1	F	65	5	380
29	S 1	90	70	225	900	1190	160	AH-1	F	65	5	744
29	N 1	30	32	335	300	610	80	AH-1	F	65	5	763
29	N24	360	357	51	500	1060	200	AH-1	F	65	5	530
29	N 4	90	22	46	500	875	100	AH-1	F	65	5	875
29	N26	330	327	46	1200	1000	110	AH-1	F	65	5	909
29	N 3	90	79	43	1000	900	110	AH-1	F	65	5	119
28	N16	30	28	37	200	330	80	AH-1	F	60	3	413
28	N19	0	2	37	50	340	70	AH-1	F	60	3	4[illegible]
28	N27	0	2	37	50	340	70	AH-1	F	60	3	416
28	N15	0	38	37	100	350	90	AH-1	F	60	3	319
28	N13	999	336	44	9999	160	90	AH-1	F	60	3	178
28	N14	999	336	44	9999	160	90	AH-1	F	60	3	178
28	N23	90	81	44	75	390	80	AH-1	F	60	3	488
28	N12	270	308	37	1	100	100	AH-1	F	60	3	100
28	S 3	60	39	218	600	1130	400	AH-1	F	65	3	237
28	S 7	60	32	219	50	550	500	AH-1	F	65	3	110
28	N 1	15	18	45	100	640	360	AH-1	F	70	3	178
28	N24	30	14	43	100	540	260	AH-1	F	70	3	208
28	N 4	60	31	43	200	820	210	AH-1	F	70	3	390
28	N26	300	334	35	200	670	310	AH-1	F	70	3	216
28	N 3	90	60	52	500	975	300	AH-1	F	70	3	325
33	N10	270	256	48	1500	470	420	OH-58	L	60	0	112
33	N16	30	30	48	2000	450	260	OH-58	L	60	0	173
33	N19	0	6	48	1000	400	220	OH-58	L	60	0	182
33	N27	0	6	48	1000	400	220	OH-58	L	60	0	182
33	N15	0	26	48	1500	510	200	OH-58	L	60	0	255
33	N23	60	17	48	100	540	240	OH-58	L	60	0	225
33	N12	360	354	39	1000	370	170	OH-58	L	60	0	218
33	N22	270	263	39	9999	250	240	OH-58	L	60	0	104
33	S22	270	301	227	1500	450	301	OH-58	L	60	0	150
33	S 3	60	39	227	2000	940	280	OH-58	L	60	0	336
33	S 9	300	330	228	1500	670	190	OH-58	L	60	0	353

TABLE 32(CONTINUED)

FLIGHT DATA-SERIES 3

FLIGHT	TGT	ERB	PRB	HDG	ER	PR	AGL	ACFT	POS	HS	EXP	SHP
33	S 7	0	3	229	9999	760	280	OH-58	L	60	0	271
33	S 4	60	53	230	3000	1310	190	OH-58	L	60	0	[illegible]
33	N 1	9	11	52	1000	540	220	OH-58	L	60	0	245
33	N24	360	357	46	2000	590	260	OH-58	L	60	0	[illegible]
33	N 4	15	19	46	3000	750	330	OH-58	L	60	0	[illegible]
33	N26	270	268	46	3000	540	220	OH-58	L	60	0	245
33	N 3	90	68	43	3000	900	330	OH-58	L	60	0	273
45	N10	300	301	54	500	600	550	OH-58	L	60	0	[illegible]
45	N17	0	11	54	1200	1290	310	OH-58	L	60	0	416
45	N16	330	353	52	600	720	310	OH-58	L	60	0	[illegible]
45	N19	300	331	52	500	530	230	OH-58	L	60	0	[illegible]
45	N27	300	331	52	500	530	230	OH-58	L	60	0	[illegible]
45	N11	240	205	44	500	550	270	OH-58	L	60	0	204
45	N23	0	17	58	100	190	250	OH-58	L	60	0	76
45	N13	240	256	32	400	470	300	OH-58	L	60	0	157
45	N12	270	277	17	100	240	260	OH-58	L	60	0	82
45	N22	270	258	17	300	610	280	OH-58	L	60	0	[illegible]
45	S22	300	328	217	400	660	250	OH-58	L	60	0	264
45	S27	285	317	213	300	640	240	OH-58	L	60	0	267
45	S19	285	317	213	300	640	240	OH-58	L	60	0	267
45	S16	270	308	223	400	700	250	OH-58	L	60	0	[illegible]
45	S 3	60	40	223	600	1800	280	OH-58	L	60	0	243
45	S10	330	346	236	9999	230	470	OH-58	L	60	0	49
45	S 7	30	32	236	200	700	440	OH-58	L	60	0	159
45	S 1	45	36	249	2000	2320	340	OH-58	L	60	0	432
45	N 1	30	9	36	100	550	400	OH-58	L	55	0	126
45	N24	30	10	57	400	1300	410	OH-58	L	55	0	317
45	N 4	30	24	40	100	650	340	OH-58	L	55	0	191
45	N 5	90	103	65	200	590	350	OH-58	L	55	0	169
45	N26	270	262	65	300	720	330	OH-58	L	55	0	218
45	N 3	60	45	46	300	650	260	OH-58	L	55	0	250
54	A 4	240	247	49	2200	2255	330	OH-58	L	60	8	[illegible]
54	N10	270	246	49	200	530	220	OH-58	L	60	8	241
54	N11	270	353	48	50	180	180	OH-58	L	60	8	[illegible]
54	N19	0	6	48	100	240	170	OH-58	L	60	8	141
54	N27	0	6	48	100	240	170	OH-58	L	60	8	141
54	N14	300	350	48	50	230	160	OH-58	L	60	8	144
54	N13	300	350	48	50	130	140	OH-58	L	60	8	93
54	N23	90	76	40	100	430	150	OH-58	L	60	8	287
54	N22	270	283	39	100	400	150	OH-58	L	60	8	267

TABLE 32(CONTINUED)

FLIGHT DATA-SERIES 3

FLIGHT	TGT	ERB	PRB	HDG	ER	PR	AGL	ACFT	POS	AS	EXP	EAR
54	N12	210	210	39	100	75	200	OH-58	L	60	8	38
54	S22	270	293	227	200	440	140	OH-58	L	60	8	314
54	S 3	30	29	228	2000	1320	250	OH-58	L	60	8	528
54	S 9	300	331	229	200	830	250	OH-58	L	60	8	332
54	S10	270	290	232	200	530	350	OH-58	L	60	8	151
54	S 7	0	6	231	100	650	240	OH-58	L	60	8	271
54	S 4	90	75	228	400	1100	330	OH-58	L	60	8	333
54	S 5	60	103	231	700	700	250	OH-58	L	60	8	280
54	S 1	120	101	228	600	1150	400	OH-58	L	60	8	288
54	N 1	0	12	52	100	480	170	OH-58	L	60	8	282
54	N24	0	0	44	300	820	280	OH-58	L	60	8	297
54	N 4	30	18	44	200	900	260	OH-58	L	60	8	346
54	N26	300	331	44	300	1030	220	OH-58	L	60	8	468
54	N 3	90	64	46	400	930	300	OH-58	L	60	8	310
34	N10	270	278	71	1000	600	280	AH-1	R	60	2	214
34	A 3	270	237	45	10	1980	210	AH-1	R	60	2	943
34	N16	30	27	45	10	310	130	AH-1	R	60	2	238
34	N19	0	0	45	300	310	120	AH-1	R	60	2	258
34	N27	0	0	45	300	310	120	AH-1	R	60	2	258
34	N23	60	43	45	500	540	180	AH-1	R	60	2	300
34	N13	270	319	45	10	100	160	AH-1	R	60	2	63
34	N14	270	319	45	10	100	160	AH-1	R	60	2	63
34	N22	270	284	28	500	450	130	AH-1	R	60	2	346
34	N12	270	319	28	10	130	150	AH-1	R	60	2	87
34	S22	270	293	230	500	430	250	AH-1	R	70	2	172
34	S 3	90	45	212	1000	1080	280	AH-1	R	70	2	366
34	S 9	300	345	217	10	490	230	AH-1	R	70	2	213
34	S 8	345	347	227	500	820	380	AH-1	R	70	2	216
34	S 1	90	82	235	1500	1250	260	AH-1	R	70	2	481
34	N 1	60	16	46	500	560	310	AH-1	R	65	2	181
34	N24	0	2	52	500	460	320	AH-1	R	65	2	144
34	N 6	60	34	42	900	1100	380	AH-1	R	65	2	289
34	N 4	999	98	40	9999	390	270	AH-1	R	65	2	144
34	N26	270	277	42	500	390	240	AH-1	R	65	2	163
34	N 3	75	63	56	1500	950	370	AH-1	R	65	2	257
56	N10	300	303	61	300	610	180	AH-1	R	65	6	339
56	N11	270	263	48	200	140	140	AH-1	R	65	6	100
56	N16	90	68	44	100	140	150	AH-1	R	65	6	93
56	N17	150	137	39	500	690	160	AH-1	R	65	6	431
56	N15	90	77	39	200	240	120	AH-1	R	65	6	200

TABLE 32(CONTINUED)

FLIGHT DATA-SERIES 3

FLIGHT	TGT	ERB	PRB	HDG	ER	PR	AGL	ACFT	POS	AS	EXP	CAR
56	N13	360	204	39	10	90	150	AH-1	R	65	6	60
56	N23	90	93	39	300	400	180	AH-1	R	65	6	222
56	N12	340	300	39	200	210	150	AH-1	R	65	6	140
56	N22	270	245	42	400	420	160	AH-1	R	65	6	263
56	S22	270	283	232	600	710	190	AH-1	R	70	6	374
56	S 3	60	42	216	1000	1190	290	AH-1	R	70	6	410
56	S 9	330	353	214	500	820	150	AH-1	R	70	6	547
56	S10	270	329	219	200	250	340	AH-1	R	70	6	74
56	S 8	300	340	219	300	430	340	AH-1	R	70	6	126
56	S 7	90	68	234	300	430	270	AH-1	R	70	6	148
56	N 1	30	16	9	400	690	260	AH-1	R	70	6	265
56	N24	0	0	57	800	1035	400	AH-1	R	70	6	259
56	N 4	30	11	51	500	975	270	AH-1	R	70	6	361
56	N26	330	328	51	800	1120	120	AH-1	R	70	6	933
56	N 3	90	68	52	600	960	230	AH-1	R	70	6	417
55	N10	270	247	50	300	530	220	AH-1	R	60	10	241
55	N16	60	60	44	50	370	90	AH-1	R	60	10	411
55	N11	120	174	44	25	200	110	AH-1	R	60	10	182
55	N19	0	0	44	10	30	100	AH-1	R	60	10	30
55	N27	0	0	44	10	30	100	AH-1	R	60	10	30
55	N14	0	0	44	10	160	160	AH-1	R	60	10	100
55	N23	90	89	44	100	430	100	AH-1	R	60	10	430
55	N22	270	273	44	500	370	100	AH-1	R	60	10	370
55	N12	360	219	44	10	90	150	AH-1	R	60	10	60
55	S22	270	315	226	100	490	210	AH-1	R	65	10	233
55	S27	240	285	231	150	900	340	AH-1	R	65	10	265
55	S19	240	285	231	50	900	340	AH-1	R	65	10	265
55	S 3	75	49	229	200	810	350	AH-1	R	65	10	231
55	S 9	270	315	230	150	520	510	AH-1	R	65	10	102
55	S10	270	288	237	200	550	390	AH-1	R	65	10	141
55	S 7	0	0	233	150	400	130	AH-1	R	65	10	308
55	S 5	90	60	231	400	880	200	AH-1	R	65	10	440
55	N 1	30	26	36	200	580	240	AH-1	R	60	10	242
55	N24	90	97	44	50	130	280	AH-1	R	60	10	46
55	N 4	75	46	44	200	490	360	AH-1	R	60	10	136
55	N26	270	276	45	200	430	330	AH-1	R	60	10	130
55	N 3	75	73	49	600	960	460	AH-1	R	60	10	209
53	N16	0	17	53	300	360	180	AH-1	R	65	4	200
53	N19	300	347	48	150	340	120	AH-1	R	65	4	283
53	N27	300	347	48	150	340	120	AH-1	R	65	4	283

TABLE 32(CONTINUED)

FLIGHT DATA-SERIES 3

FLIGHT	TGT	ERB	PRB	HDG	ER	PR	AGL	ACFT	POS	AS	EXP	EAR
53	N23	60	48	40	200	420	160	AH-1	R	65	4	263
53	N15	90	70	40	100	160	140	AH-1	R	65	4	114
53	S 9	300	342	215	100	440	210	AH-1	R	65	4	210
53	S10	315	317	221	100	380	230	AH-1	R	65	4	165
53	S 8	270	327	219	100	410	390	AH-1	R	65	4	105
53	N 1	30	30	280	200	630	370	AH-1	R	65	4	170
53	N24	30	22	44	100	250	110	AH-1	R	65	4	227
53	N 4	30	28	44	700	670	220	AH-1	R	65	4	305
53	N26	270	264	39	200	390	160	AH-1	R	65	4	244
53	N 3	90	78	52	800	920	400	AH-1	R	65	4	230
52	N10	270	275	51	1000	480	350	AH-1	F	65	3	137
52	N 9	270	278	51	1500	610	310	AH-1	F	65	3	197
52	N16	60	33	45	500	370	190	AH-1	F	65	3	195
52	N19	0	7	45	100	290	190	AH-1	F	65	3	153
52	N27	0	7	45	100	290	190	AH-1	F	65	3	153
52	N15	30	34	45	800	410	190	AH-1	F	65	3	216
52	N23	45	47	45	800	580	210	AH-1	F	65	3	276
52	N22	270	294	45	800	430	180	AH-1	F	65	3	239
52	N12	210	230	44	500	50	220	AH-1	F	65	3	23
52	S22	270	321	228	1000	540	420	AH-1	F	65	3	129
52	S27	340	348	233	500	980	340	AH-1	F	65	3	288
52	S19	340	348	233	500	980	340	AH-1	F	65	3	288
52	S 3	90	64	230	800	630	140	AH-1	F	65	3	450
52	S 9	240	263	236	1000	420	460	AH-1	F	65	3	91
52	S 4	75	65	227	1080	1000	360	AH-1	F	65	3	278
52	S 1	90	69	227	1500	1200	390	AH-1	F	65	3	308
52	N 1	15	14	51	500	580	400	AH-1	F	65	3	145
52	N24	0	5	46	1000	570	510	AH-1	F	65	3	112
52	N 2	300	327	46	1500	950	490	AH-1	F	65	3	194
52	N 4	120	90	45	800	330	470	AH-1	F	65	3	70
52	N 6	105	113	45	2000	770	360	AH-1	F	65	3	214
52	N 3	90	92	48	2500	915	650	AH-1	F	65	3	141
51	N10	300	289	52	1500	520	270	AH-1	F	60	5	193
51	N11	300	270	42	100	100	140	AH-1	F	60	5	71
51	N19	0	3	39	9999	290	140	AH-1	F	60	5	207
51	N27	0	3	39	9999	290	140	AH-1	F	60	5	207
51	N13	345	345	46	1500	280	100	AH-1	F	60	5	280
51	N14	345	345	46	1500	280	100	AH-1	F	60	5	280
51	N15	90	76	49	500	190	150	AH-1	F	60	5	127
51	N23	60	76	49	9999	350	120	AH-1	F	60	5	292

TABLE 32(CONTINUED)

FLIGHT DATA-SERIES 3

FLIGHT	TGT	ERB	PRB	HDG	ER	FR	AGL	ACFT	POS	AS	EXP	EAR
51	N22	270	265	41	100	460	130	AH-1	F	60	5	354
51	N12	270	304	41	100	160	130	AH-1	F	60	5	123
51	S22	270	286	227	2000	690	290	AH-1	F	60	5	238
51	S 3	60	43	216	4000	1060	390	AH-1	F	60	5	272
51	S 9	300	340	216	500	370	290	AH-1	F	60	5	128
51	S 7	90	98	227	1500	450	360	AH-1	F	60	5	125
51	S 1	90	92	237	2500	1330	530	AH-1	F	65	5	251
51	N 1	30	21	60	500	360	340	AH-1	F	65	5	106
51	N24	0	0	50	9999	830	360	AH-1	F	65	5	231
51	N 6	60	53	42	2000	880	310	AH-1	F	65	5	284
51	N 4	30	47	42	9999	490	300	AH-1	F	65	5	163
51	N26	300	312	32	1500	600	290	AH-1	F	65	5	207
51	N 3	90	85	44	2000	960	740	AH-1	F	65	5	130
49	N 8	270	257	47	800	500	190	AH-1	F	60	2	263
49	N10	300	294	47	600	540	190	AH-1	F	60	2	284
49	N11	270	312	48	100	180	[illegible]	AH-1	F	60	2	180
49	N16	90	29	48	100	220	140	AH-1	F	60	2	157
49	N19	270	340	48	10	170	[illegible]	AH-1	F	60	2	121
49	N27	270	340	48	10	170	140	AH-1	F	60	2	121
49	N13	270	318	40	100	130	140	AH-1	F	60	2	93
49	N14	270	318	40	100	130	140	AH-1	F	60	2	93
49	N15	90	100	37	100	170	120	AH-1	F	60	2	142
49	N23	90	92	37	100	370	80	AH-1	F	60	2	463
49	N22	270	269	37	500	430	130	AH-1	F	60	2	331
49	N12	270	270	37	100	80	100	AH-1	F	60	2	80
49	S 3	90	85	219	800	730	340	AH-1	F	70	2	215
49	S 9	270	298	219	100	190	310	AH-1	F	70	2	61
49	S 8	270	316	219	200	250	280	AH-1	F	70	2	89
49	S 7	90	71	223	400	430	290	AH-1	F	70	2	148
49	N 1	0	22	47	500	580	300	AH-1	F	65	2	193
49	N24	360	358	51	600	500	360	AH-1	F	65	2	139
49	N 4	60	23	42	600	680	290	AH-1	F	65	2	234
49	N26	300	323	42	500	730	270	AH-1	F	65	2	270
49	N 6	120	91	42	800	720	150	AH-1	F	65	2	480
49	N 3	55	90	55	800	1020	200	AH-1	F	65	2	510
44	N16	30	17	45	9999	560	100	AH-1	R	65	2	560
44	N11	270	316	45	9999	130	100	AH-1	R	65	2	130
44	N19	999	1	45	9999	270	110	AH-1	R	65	2	245
44	N27	999	1	45	9999	270	110	AH-1	R	65	2	245
44	N15	60	46	45	9999	300	150	AH-1	R	65	2	200

TABLE 32(CONTINUED)

FLIGHT DATA-SERIES 3

FLIGHT	TGT	ERB	PRB	HDG	ER	PR	AGL	ACFT	POS	AS	EXP	EAR
44	N13	180	212	45	9999	100	160	AH-1	R	65	2	63
44	N14	180	212	45	9999	100	160	AH-1	R	65	2	63
44	N12	270	332	45	9999	130	160	AH-1	R	65	2	81
44	N23	30	50	45	9999	460	120	AH-1	R	65	2	383
44	S22	240	270	220	9999	250	250	AH-1	R	70	2	100
44	S27	270	270	220	9999	640	160	AH-1	R	70	2	400
44	S19	270	270	220	9999	640	160	AH-1	R	70	2	400
44	S 3	75	44	220	500	1210	250	AH-1	R	70	2	484
44	S 9	120	90	220	100	70	220	AH-1	R	70	2	32
44	S 7	60	45	220	150	700	280	AH-1	R	70	2	250
44	N 1	30	46	55	100	640	320	AH-1	R	70	2	200
44	N24	30	10	55	50	330	310	AH-1	R	70	2	106
44	N 4	60	23	45	100	730	230	AH-1	R	70	2	317
44	N26	270	298	35	100	350	270	AH-1	R	70	2	130
44	N 2	270	298	35	100	350	270	AH-1	R	70	2	130
44	N 3	30	50	55	500	1050	310	AH-1	R	70	2	339

TABLE 33

FLIGHT DATA-SERIES 4

FLIGHT	TGT	ERR	PRR	HDG	ER	PR	AGL	ACFT	POS	AS	EXP
1	10	360	354	220	800	640	5	OH-58	CR	50	3
1	12	270	270	260	400	470	5	OH-58	CR	20	3
1	14	999	335	230	150	120	10	OH-58	CR	20	3
1	15	360	5	130	350	520	5	OH-58	CR	20	3
2	11	999	345	190	9999	220	20	OH-58	CR	25	8
2	12	360	360	200	600	770	25	OH-58	CR	40	8
2	13	360	15	285	400	350	25	OH-58	CR	45	8
2	14	999	5	260	200	370	30	OH-58	CR	45	8
2	15	999	80	230	200	160	30	OH-58	CR	45	8
3	10	360	11	240	700	1050	30	OH-58	CR	40	3
3	11	210	210	210	10	320	20	OH-58	CR	40	3
3	12	330	317	210	700	780	30	OH-58	CR	40	3
4	12	300	286	255	2000	1425	30	OH-58	CR	40	10
4	14	90	24	160	200	230	30	OH-58	CR	40	10
4	15	330	320	170	800	460	30	OH-58	CR	40	10
5	10	270	300	180	1200	1125	35	OH-58	CR	40	3
5	12	330	258	270	1500	565	35	OH-58	CR	40	3
5	13	150	165	200	1500	145	30	OH-58	CR	35	3
5	14	330	352	240	500	220	35	OH-58	CR	40	3
5	15	30	30	180	300	340	30	OH-58	CR	35	3
6		999	999	999	9999	9999	50	OH-58	CR	50	3

Note: Field of 9's indicates no data for this entry.

The target data (Table 34) lists the indivdual target properties for the 15 APG targets and those of the 23 NWC targets. Many of the NWC targets were available to the observer on more than one of the legs of the three-leg course flown hence the 'N,' 'S,' and 'A' preceding the target numbers.

The legend used is as follows:

TARGET	Target number.
HDG	Heading of the target in degrees.
EL	Elevation of the target in feet.
OC	Perpendicular distance from the planned route to the target in meters.
CL	Difficulty classification code for the target.
TER	Terrain classification code for the target area.
L	Target length in inches.
H	Target height in inches.
W	Target width in inches.
VOL	Target volume in cubic feet.
MTAI	Maximum time in seconds that the target was available to the observer for acquisition prior to reaching the abeam point.
MTAD	Maximum distance in meters at which the target could be acquired at the briefed altitude.

The difficulty classification ranged from a value of '1' for a target that was very difficult to see such as NWC 2 (Fig. 6A) to a value of '12' for a target that was extremely easy to see such as APG 3 (Fig. 26A). The terrain classification code ranged from '1' for an area that had a slope of less than 1 degree to a value of '10' for an area whose slope was greater than 9 degrees.

The value used in this study to depict the property of the target to be seen against its ground was called the Conspicuity Value. This differs from the classical contrast value in that it is the difference between the highest and lowest brightness values divided by the highest value without regard as to whether the target or the ground was the source of the highest brightness value. The rationale is that a dark target on a bright ground was as conspicuous to the observer as a bright target on a dark ground.

A SPECTRA Brightness Spot Meter was used to obtain the brightness values used to compute the conspicuity values for the flight tests performed at APG (Table 35). All readings were taken from a helicopter on the briefed flight heading and altitude.

The NWC values were computed from the COSO Range photometer readings contained in a letter from NWC (Appendix B).

Tables 36 through 41 show the scores and clutter factors for the HELHAT I flights at NWC. Table 42 gives the flight order followed at NWC and Table 43 gives the meterological conditions during those flights.

TABLE 34

TARGET DATA

TARGET	HDG	EL	GC	CL	TER	L	H	W	VOL	MTAI	MTAD
1	78	40	270	11	1	245	178	95	2397	57.41	1772
2	55	40	370	8	1	96	12	48	32	19.75	602
3	308	91	460	12	1	245	252	95	3394	57.58	1777
4	130	17	330	5	1	96	12	48	32	15.20	469
5	239	10	220	11	1	278	216	98	3405	19.73	609
6	70	12	100	7	1	139	73	61	434	25.84	489
7	11	6	1000	6	1	96	24	48	64	50.71	1565
8	15	4	2390	2	1	263	93	93	1316	9.80	299
9	90	14	1280	4	1	263	93	93	1316	26.02	803
10	36	3	130	6	1	96	12	48	32	18.50	564
11	92	13	550	1	1	263	93	93	1316	3.00	91
12	106	19	180	9	1	96	24	48	64	7.26	224
13	69	25	770	5	1	165	56	79	422	16.75	510
14	35	28	290	7	1	165	56	79	422	12.80	395
15	76	34	160	10	1	96	12	48	32	23.00	701
N 1	281	6716	95	6	9	293	118	144	2881	21.61	667
S 1	281	6716	1100	6	9	293	118	144	2881	60.82	1877
N 2	261	6843	494	1	6	236	62	85	720	29.74	918
N 3	156	6970	831	8	5	269	112	96	1674	27.17	837
S 3	156	6970	549	8	5	269	112	96	1674	44.68	1379
N 4	348	6853	280	11	6	256	118	96	1678	57.54	1776
S 4	348	6853	1006	10	6	256	118	96	1678	48.37	1493
N 5	43	6974	628	2	1	250	112	101	1637	12.54	387
S 5	43	6974	658	2	1	250	112	101	1637	19.50	602
N 6	186	6866	625	3	5	210	108	97	1273	38.33	1183
S 6	186	6866	660	3	5	210	108	97	1273	24.00	732
N 7	71	6902	1040	8	5	2040	96	192	21760	22.87	706
S 7	71	6902	28	12	5	2040	96	192	21760	24.59	759
N 8	211	6900	469	11	5	372	106	99	2259	9.20	284
S 8	211	6900	570	10	5	372	106	99	2259	25.89	799
N 9	21	6952	600	4	9	242	125	98	1715	8.83	269
S 9	21	6952	372	3	9	242	125	98	1715	50.51	1559
N 10	206	6930	475	6	9	242	125	98	1715	15.84	483
S 10	206	6930	518	6	9	242	125	98	1715	15.80	482
N 11	61	7543	28	11	2	305	108	102	1944	9.00	274
S 11	61	7543	830	10	2	305	108	102	1944	3.14	97
N 12	46	7681	91	11	9	94	94	60	307	14.32	442
N 13	146	7657	30	5	6	139	36	61	177	16.82	519
S 13	145	7657	780	5	6	139	36	61	177	18.14	560
N 14	271	7658	1	9	6	305	108	102	1944	12.12	374

TABLE 34(CONTINUED)

TARGET DATA

TARGET	HDG	EL	OC	CL	TER	L	H	W	VOL	MTAI	MTAD
N 15	6	7624	244	4	5	276	118	139	2620	14.87	459
N 16	126	7591	238	10	3	242	212	98	2910	32.30	997
S 16	126	7591	1065	10	3	242	212	98	2910	13.96	431
N 17	196	7536	552	2	5	372	106	99	2259	41.05	1267
N 19	6	7592	67	9	5	185	74	74	578	20.41	630
S 19	6	7592	890	9	5	185	74	74	578	31.07	959
N 22	66	7704	396	8	5	1000	120	1000	69445	21.45	662
S 22	66	7704	393	8	5	1000	120	1000	69445	20.35	628
N 23	81	7592	411	7	10	2736	300	312	148200	21.81	673
N 24	121	6850	28	10	10	1920	480	192	102400	47.37	1462
S 24	121	6850	28	10	10	1920	480	192	102400	23.00	701
N 26	261	6834	540	9	6	199	74	78	665	30.78	950
S 26	261	6834	355	9	6	199	74	78	665	3.14	97
N 27	226	7592	30	10	5	504	109	98	3115	20.41	630
S 27	226	7592	30	10	5	504	109	98	3115	31.07	959
A 3	156	6970	1500	8	5	269	112	96	1674	3.00	91
A 4	348	6853	2060	9	6	256	118	96	1678	3.00	91

TABLE 35

APG FOREGROUND AND BACKGROUND CONSPICUITY VALUES (%)

DATE	TARGET 1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		CONDITIONS VIS	CLOUDS
	FG	BG	FG	BG	FG	BG	FG	BG	FG	BG	FG	BG	FG	BG	FG	BG	FG	BG	FG	BG	FG	BG	FG	BG	FG	BG	FG	BG	FG	BG	Miles	Tenths
24/7/73																															7	1
25/7/73	21	15	30	20	20	35	25	87	10	20	12	50	0	0	61	63	43	60	14	7	38	43	33	67	10	10	33	33	20	33	10	8
26/7/73	30	36	40	50	7	40	5	37	0	0	7	20	0	0	60	29	25	33	20	47	9	8	22	78	17	8	30	30	25	40	10	4
27/7/73																	17	23	20	40	50	33	0	50	4	0	17	60	25	53	10	4
6/8/73	75	67	22	11	25	37	40	67	33	67	14	71	80	67	74	60	14	25	9	8	37	37	20	30	30	45	18	33	17	50	10	4
7/8/73	83	75	73	70	40	50	50	75	20	80	33	61	25	25	40	33	19	25	18	8	37	79	20	9	71	71	50	20	33	63	8	5
8/8/73	10	10	10	0	57	47	20	60	0	81	40	67	11	11	0	50	37	17	29	43	20	20	29	86	33	33	20	75	40	58	6	1
9/8/73	50	55	18	18	9	18	30	80	12	62	43	50	38	31	38	62	23	23	40	40	50	37	17	83	14	5	67	50	43	37	5	1
10/8/73																	20	33	0	9	0	25	22	44	0	9	20	25	33	46	4	1

TABLE 36

HELHAT I NWC Data, Group One

Group One: AH-1G; Flight one, front seat; Flight two, rear seat.

Ss #	Flight	Time	Score	Clutter	Flight	Time	Score	Clutter
2	2	0955	20	33	49	1520	22	12
5	6	1058	17	26	9	0924	19	17
21	15	1330	20	29	17	1404	24	25
24	18	1428	18	22	62	1042	19	27
27	21	1604	16	27	50	0940	15	16
33	51	1018	21	25	37	1402	22	33

TABLE 37

HELHAT I NWC Data, Group Two

Group Two: AH-1G; Flight one, rear seat; Flight two, front seat.

Ss #	Flight	Time	Score	Clutter	Flight	Time	Score	Clutter
7	8	1125	14	30	63	1116	20	31
12	29	1019	23	28	68	1408	25	40
36	53	1100	13	32	46	1604	20	37
39	56	1232	20	13	40	1457	21	19
42	34	1312	21	43	66	1258	24	25
50	44	1537	21	22	60	1022	21	32

TABLE 38

HELHAT I NWC Data, Group Three

Group Three: Flight one, OH-58; Flight two, rear seat, AH-1G.

Ss #	Flight	Time	Score	Clutter	Flight	Time	Score	Clutter
22	16	1343	21	19	32	1244	18	14
25	19	1449	23	32	35	1324	22	31
1	1	0937	20	17	59	1005	19	17
13	30	1033	21	25	72	1340	21	32
18	12	1238	17	35	69	1310	24	25

TABLE 39

HELHAT I NWC Data, Group Four

Group Four: Flight one, OH-58; Flight two, front seat, AH-1G.

Ss #	Flight	Time	Score	Clutter	Flight	Time	Score	Clutter
6	7	1110	19	32	13	1254	20	33
10	27	0942	18	14	10	1204	21	16
38	45	1205	24	17	57	0918	17	37
35	54	1045	23	18	39	1414	19	34
41	33	1257	18	28	65	1229	21	22

TABLE 40

HELHAT I NWC Data, Group Five

Group Five: Flight one, front seat, AH-1G; Flight two, OH-58.

Ss #	Flight	Time	Score	Clutter	Flight	Time	Score	Clutter
3	3	1010	14	26	43	0854	16	36
8	25	0901	13	0	9	1144	20	29
11	28	0958	15	29	61	1055	22	24
26	20	1502	25	61	64	1128	28	66
30	49	0912	22	4	42	1549	28	15
34	52	1032	22	18	38	1442	24	20
15	4A	1112	24	20	68	1243	27	21

TABLE 41

HELHAT I NWC Data, Group Six

Group Six: Flight one, rear seat, AH-1G; Flight two, OH-58.

Ss #	Flight	Time	Score	Clutter	Flight	Time	Score	Clutter
4	5	1106	14	0	58	0952	19	14
14	31	1050	19	41	70	1356	25	37
20	14	1317	18	14	47	0954	21	19
28	22	1531	20	26	36	1347	26	23
37	55	1112	22	29	48	1617	22	29

TABLE 42

HELHAT I Daily Flight Order

24 October		25 October		26 October		27 October	
#	Time	#	Time	#	Time	#	Time
1	0937	25	0901	43	0854	57	0918
2	0955	26	0924	49	0912	58	0952
3	1010	27	0942	50	0940	59	1005
5	1106	28	0958	47	0954	60	1022
6	1058	29	1019	51	1018	62	1042
7	1110	30	1033	52	1032	61	1055
8	1125	31	1050	54	1045	63	1116
		4A	1112	53	1100	64	1128
		9	1144	55	1112	65	1229
		10	1204	45	1205	68	1243
		12	1238	56	1232	66	1258
		13	1254	32	1244	69	1310
		14	1317	33	1257	72	1340
		15	1330	34	1312	70	1356
		16	1343	35	1324	71	1408
		17	1404	36	1347		
		18	1428	37	1402		
		19	1449	39	1414		
		20	1502	38	1442		
		21	1604	40	1457		
		22	1531	41	1520		
				44	1537		
				42	1549		
				46	1604		
				48	1617		

TABLE 43

HELHAT I Meteorological Conditions

24 October 1972:	Clear to scattered at end of period; wind 10 to 15 K
25 October 1972:	Clear; wind 24K to 4K at end of period
26 October 1972:	Clear to scattered; wind L/V; wind 15K at end of period
27 October 1972:	Scattered to overcast at end of period; wind L/V.

DATA ANALYSIS

The theory for this FORTRAN Multiple Regression Program is described in Ballistics Research Laboratory Report No. 1330, "Stepwise Multiple Regression Statistical Theory and Computer Program Description" by Harold J. Breaux, Lloyd W. Campbell and John C. Torrrey.[4] This program is similar to the FORAST program, except symbolic formula description of the linear model is not allowed as input data. Instead, it requires that the linear model be expressed by the user as a FORTRAN[5] subroutine subprogram. In the subroutine, the model may be rescaled. It accepts a variety of control cards and data to be fitted or analyzed for correlation. This program reads the control cards, interprets them, and prints them out. The format card for the data is read following the end control card and is printed. Title cards, if any, are next and then the data for the model. After the title cards are printed, the first two sets of input data are printed, followed by the number of sets of data, the subscripts of the terms finally included in the regression, coefficients, residuals (if desired), and a limited amount of other information about the steps of regression and the accuracy of the fits (sigma's and t's).

In this analysis a "confidence value" of .95 was used. "Confidence value" is equal to 1 - alpha. This value is the confidence or probability level at which correlation is desired for entering and keeping a term in the regression. A larger confidence reduces the probability of the least significant terms being included in the regression. The program as used for this analysis determined from a table, the values for entry or removal of a term from the regression at each stage of the stepwise process for the appropriate phi and the "confidence value" specified. The table was from Theory and Problems of Statistics, page 344, by Murray R. Spiegal, published by Schaum Publishing Company, New York. This procedure allows for the most definite statement of results even when there are relatively few data points in the problem. The tolerance value that was used to check for a term being linearly dependent on one or more terms was set to .001 in the program.

The analysis of the HELHAT data consisted of 20 runs each with four conditions. These are identified on the subsequent print-outs as Run 1-1 for run one and condition 1 through 20-4 for run 20 and condition four. Table 13 identifies the runs and conditions by number. The computer printouts give the significant terms by variable number, because of the program structure each condition will have the variables numbered in a different order. Table 44 lists the variables and their order for each of the four conditions.

The printout sheets (Appendix C) give the results of each of the 80 multiple regression analyses that were made using the HELHAT data. This output data is identified as follows[5]:

SUBPROG. NO.	Condition number.
NO. OF TERMS	Number of variables considered in each equation.
RUN	Run and condition number.
NO. OF INPUT LINES	Number of equations considered.
CURR. ERMS	The value of the root-mean-square at the time the indicated is added or removed from the regression.

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[4] Breaux, H. J., Campbell, L. W., & Torrey, J. C. Stepwise multiple regression statistical theory and computer program description. BRL-R 1330. U. S. Army Ballistic Research Laboratories, Aberdeen Proving Ground, Md., 1966.

[5] U. S. Army Ballistic Research Laboratories. Stepwise multiple regression Fortran program. SPB-2-70. Aberdeen Proving Ground, Md., 1970.

TABLE 44

Variable Order

Variables	Conditions 1	2	3	4
AGL	1	1	1	1
AS	2	2	2	2
TA	3	3	3	3
TER	4	4	4	4
CL	5	5	5	5
BG	-	6	-	6
FG	-	7	-	7
OC	6	8	6	8
PRB	7	9	7	9
PR	8	10	8	10
EXP	9	11	9	11
ACFT	10	12	10	12
POS	11	13	11	13
HDG	12	14	12	14
TC	13	15	13	15
L	14	16	14	16
H	15	17	15	17
W	16	18	16	18
VOL	17	19	17	19
CF	18	20	18	20
VIS	19	21	19	21
CLD	20	22	20	22
BE	-	-	21	23
RE	-	-	22	24
α	21	23	23	25

T1 and T2	The actual values that controlled the addition or removal of the term on the line above from the regression analysis.
TA and TR	When these terms are zero it indicates that the initial T1 and T2 values were selected from the program table.
TERMS	The terms, selected as significant, by variable number.
COEFFICIENTS	Listing of the coefficients of the significant terms in the same order that the terms are listed.
SIGMAS	Listing of the Sigma value of the terms in order.
T'S	Listing of the 't' value of the terms in order.
RHO	The coefficient of Multiple Correlation.
RHO^2	The square of RHO.

The equation for the computation of RHO is:

$$\text{RHO} = \sqrt{1 - \left(\frac{\text{root-mean-square error}^2}{\sum(\text{function - average function})^2}\right) \cdot (\text{number of input lines - 1})}$$

The table in the upper right of each printout sheet contains the values of the mean and sigma for the scores for the particular run and condition. This sigma value is used in computing the BETA weighting values for each of the significant variables. The formula used was:

$$\text{BETA value} = \left(\frac{\text{Sigma of variable}}{\text{Sigma of scores}}\right) \cdot \text{Coefficient of variable}$$

The many facets of the target acquisition/detection problem were discussed in this report, we hope, in a manner which allowed the reader to understand our approach to the problem and this solution of it. When the multiple regression statistical technique has been applied to data of this type, the interpretations made of the results may sometimes be other than those that have been presented by the report.

APPENDIX A

TARGETS SEEN BY THE OBSERVERS WHILE FLYING THE DESIGNATED LEGS

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Fig. 1A. Targets 13 and 14 seen when flying a 225° Leg 1.
(Approximate course indicated by dotted line.)

Fig. 2A. Targets 23 and 15 seen when flying a 225^{O} Leg 1.
(Approximate course is indicated by dotted line.)

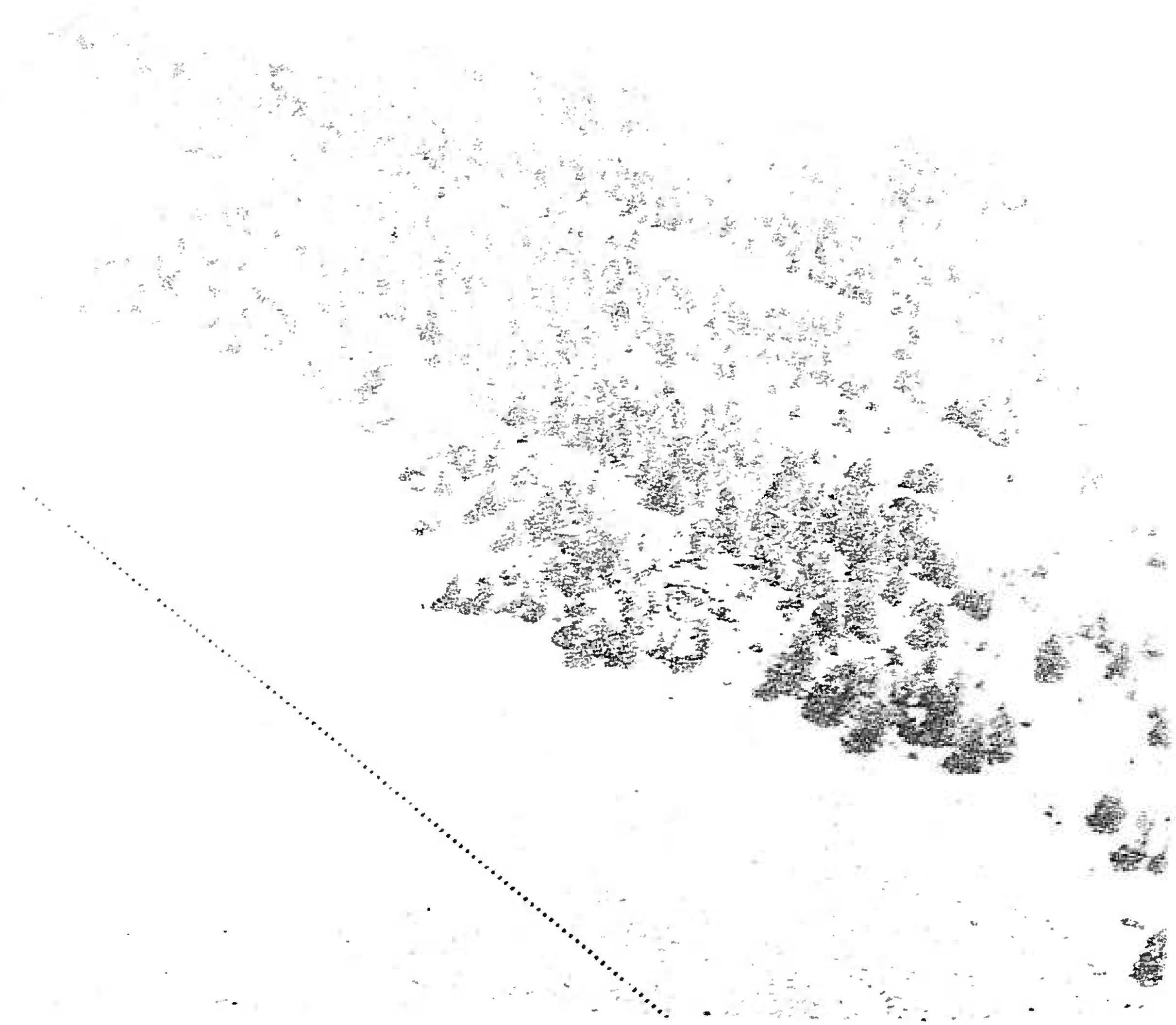

Fig. 3A. Target 11 seen when flying a 225° Leg 1.
(Approximate course is indicated by dotted line.)

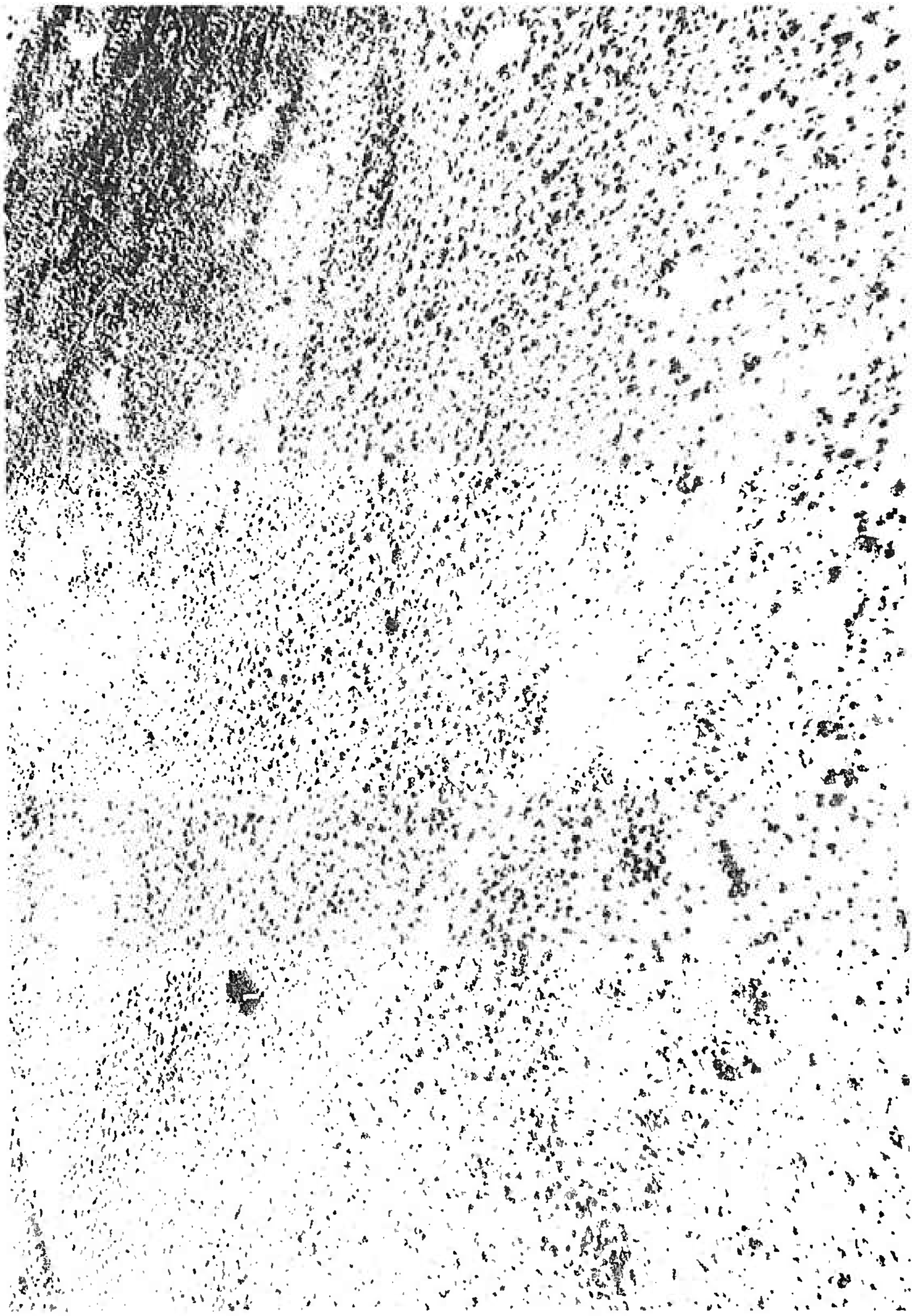

Fig. 4A. Target 1 seen when flying Leg 3.
(Approximate course is indicated by dotted line.)

Fig. 5A. Target 6 seen when flying 045° Leg 3.
(This target lies considerably to the right of the 045° course.)

Fig 6A. Target 2 from ground level.
(These howitzers are to the left of the 045° Leg 3.)

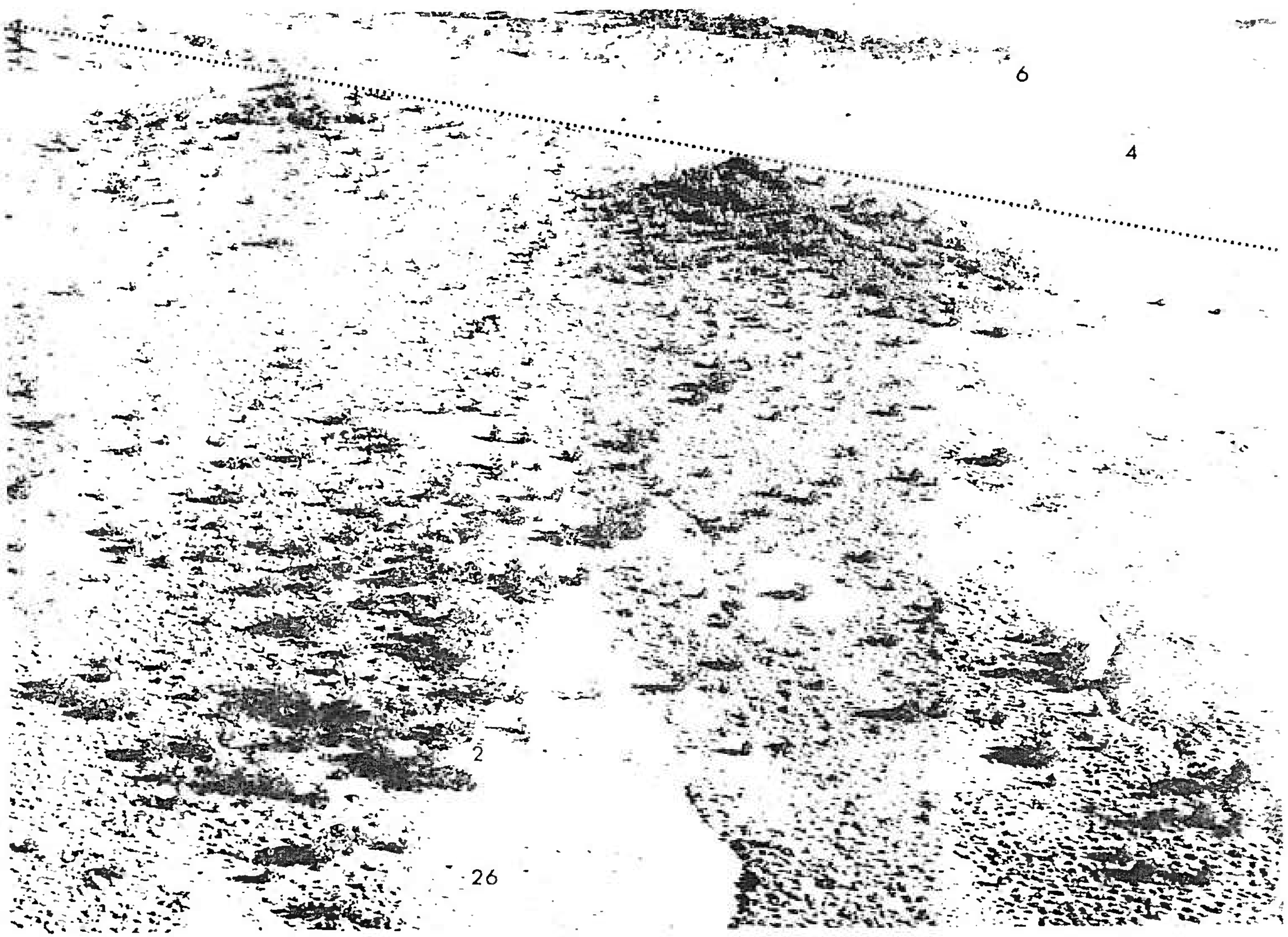

Fig. 7A. Targets seen when flying 045° Leg 3.
(Target 26 is a pickup truck which was not in place when this picture was made. Course is indicated by dotted line.

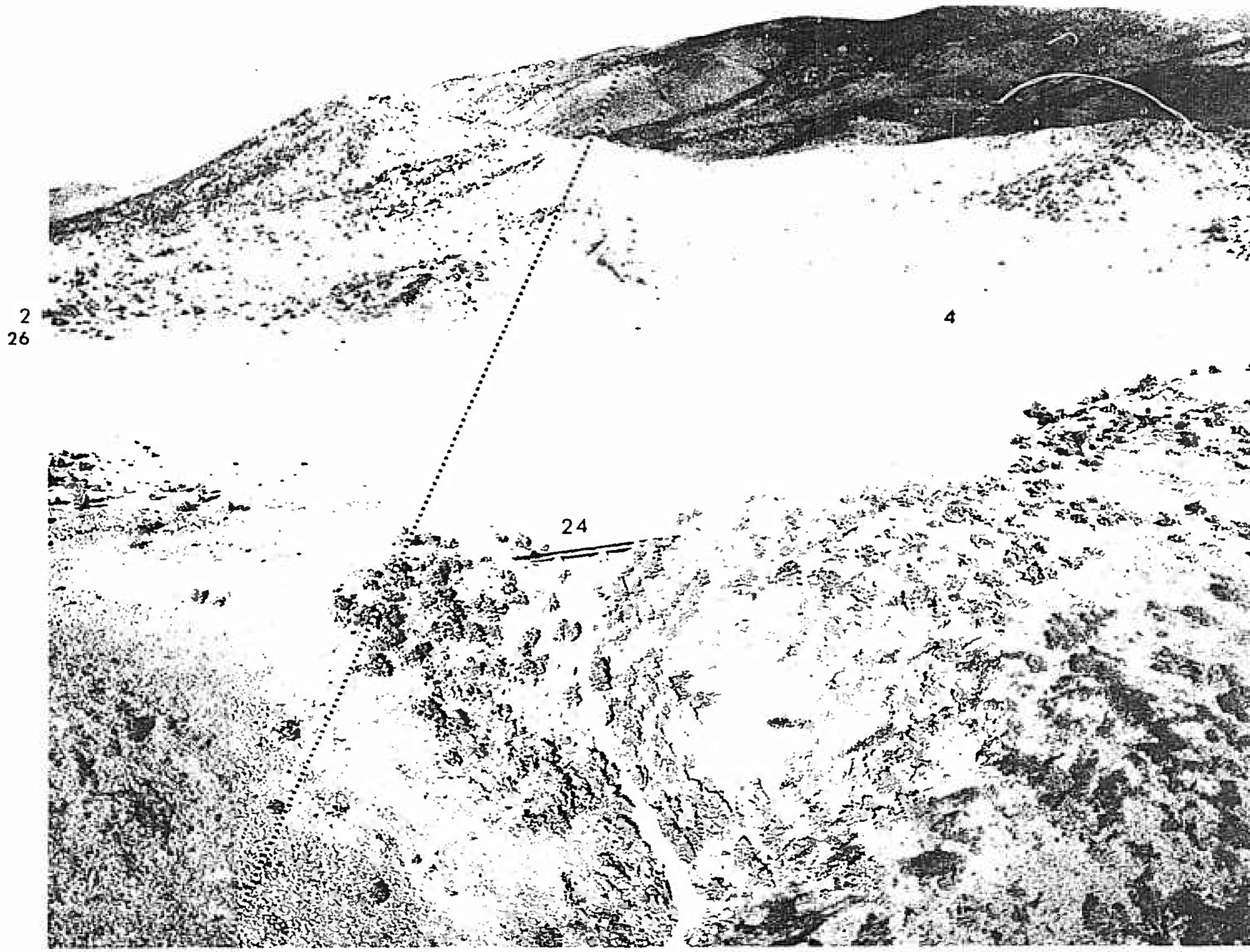

Fig. 8A. Targets seen when flying 045° Leg 3.
(Course is indicated by dotted line.)

Fig. 9A. Target 3, truck convey, seen when flying 045^{O} Leg 3 or 225^{O} Leg 2.
(The course line for Leg 3 is to the left of the picture and Leg 2 is to the right of the picture.)

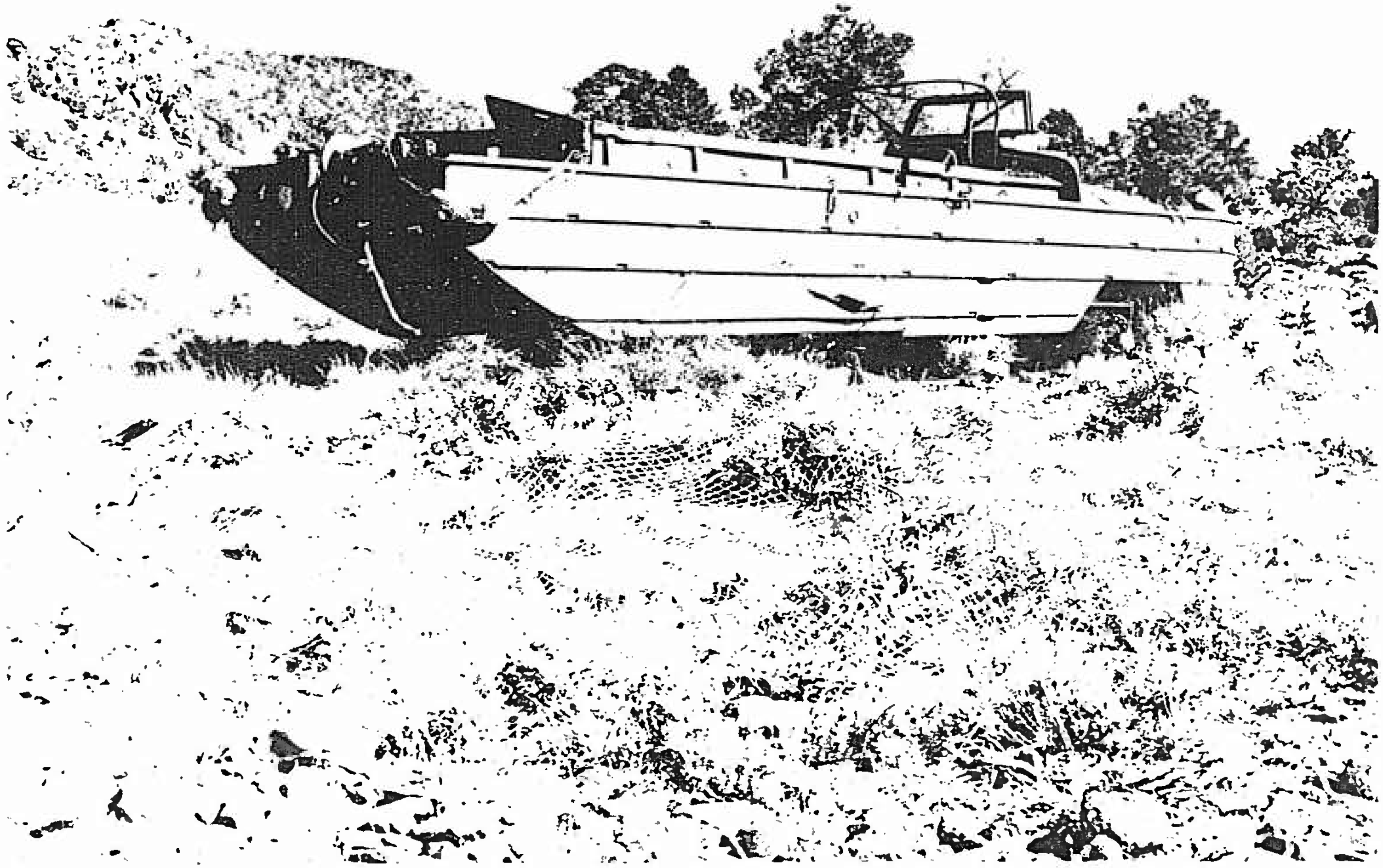

Fig. 10A. Target 17.

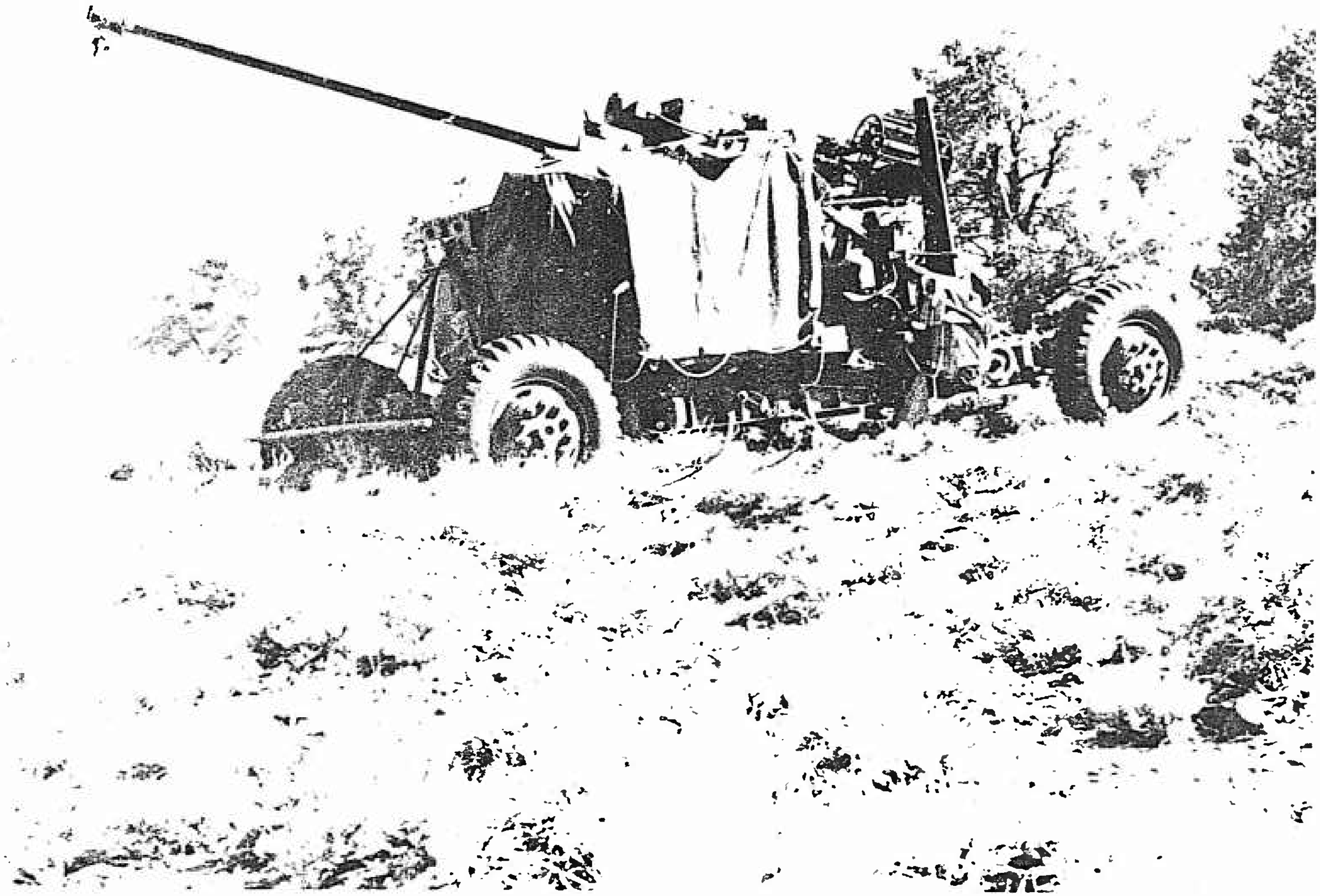

Fig. 11A. Target 11, northern most of the three guns.

Fig. 12A. Targets 18, 19, and location of Target 27.

Fig. 13A. Target 27.

Fig. 14A. Target 15.

Fig. 15A. Target 23.

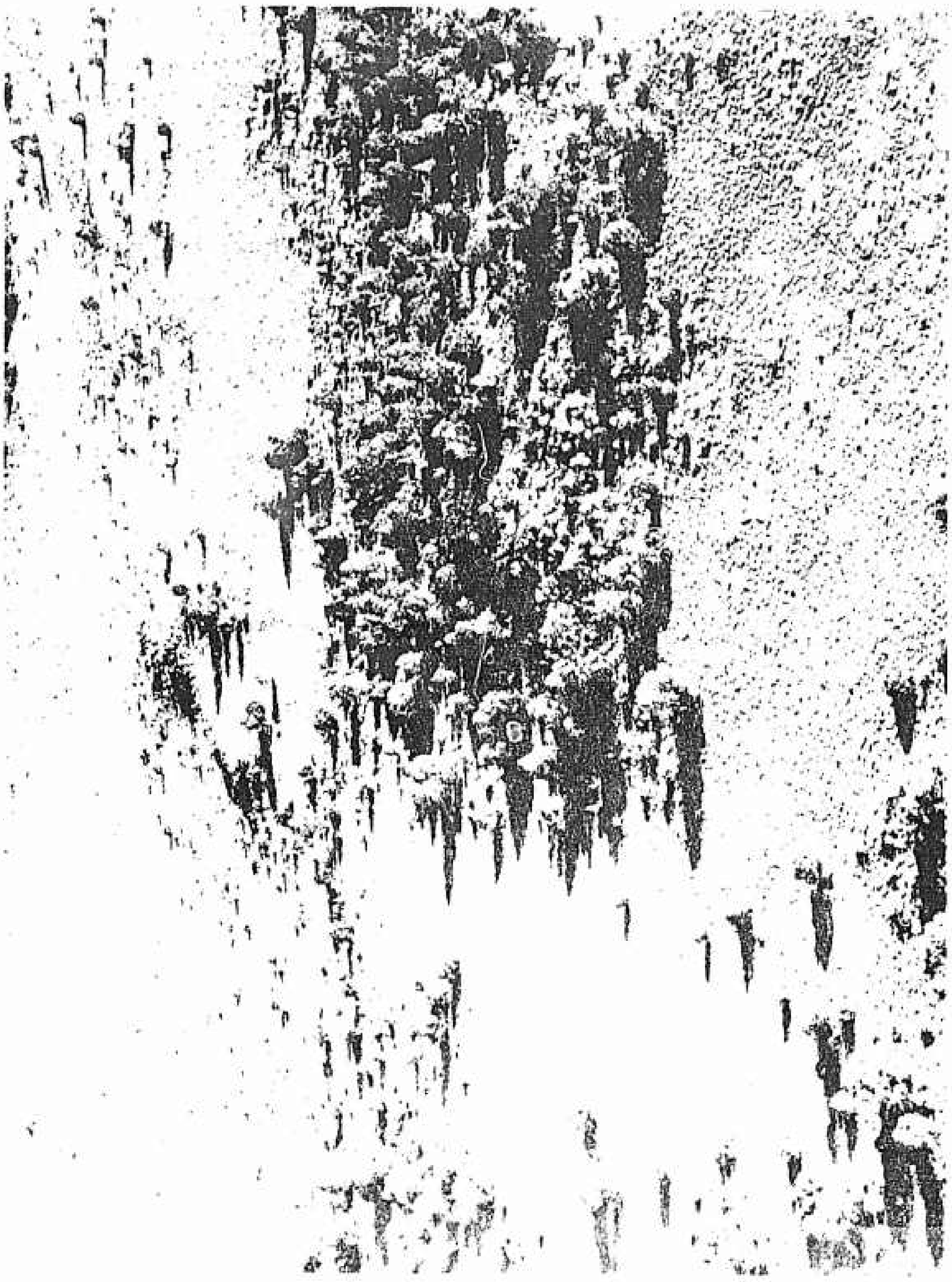

Fig. 16A. Target 12.

Fig. 17A. Target 4.

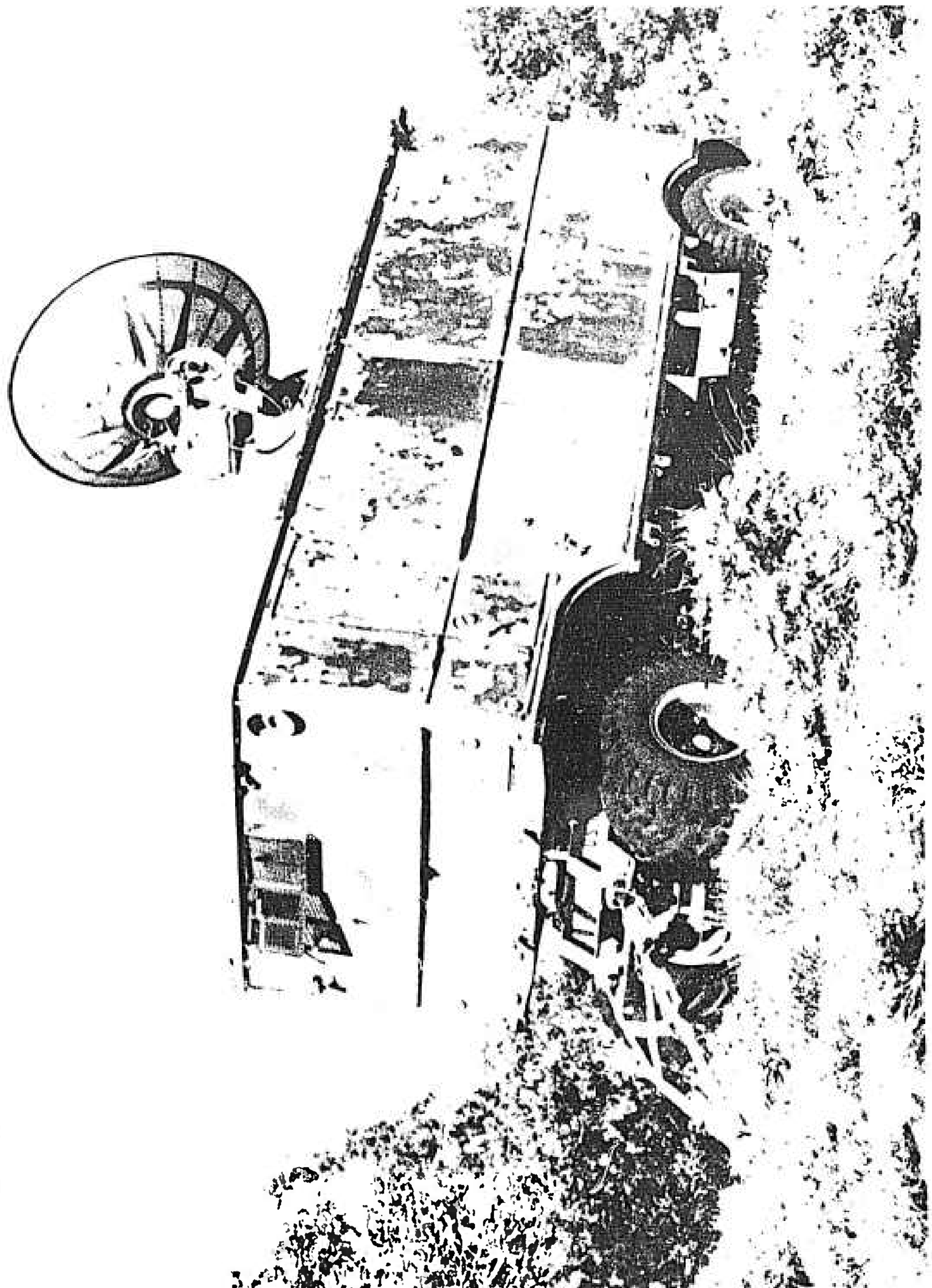

Fig. 18A. Target 16.

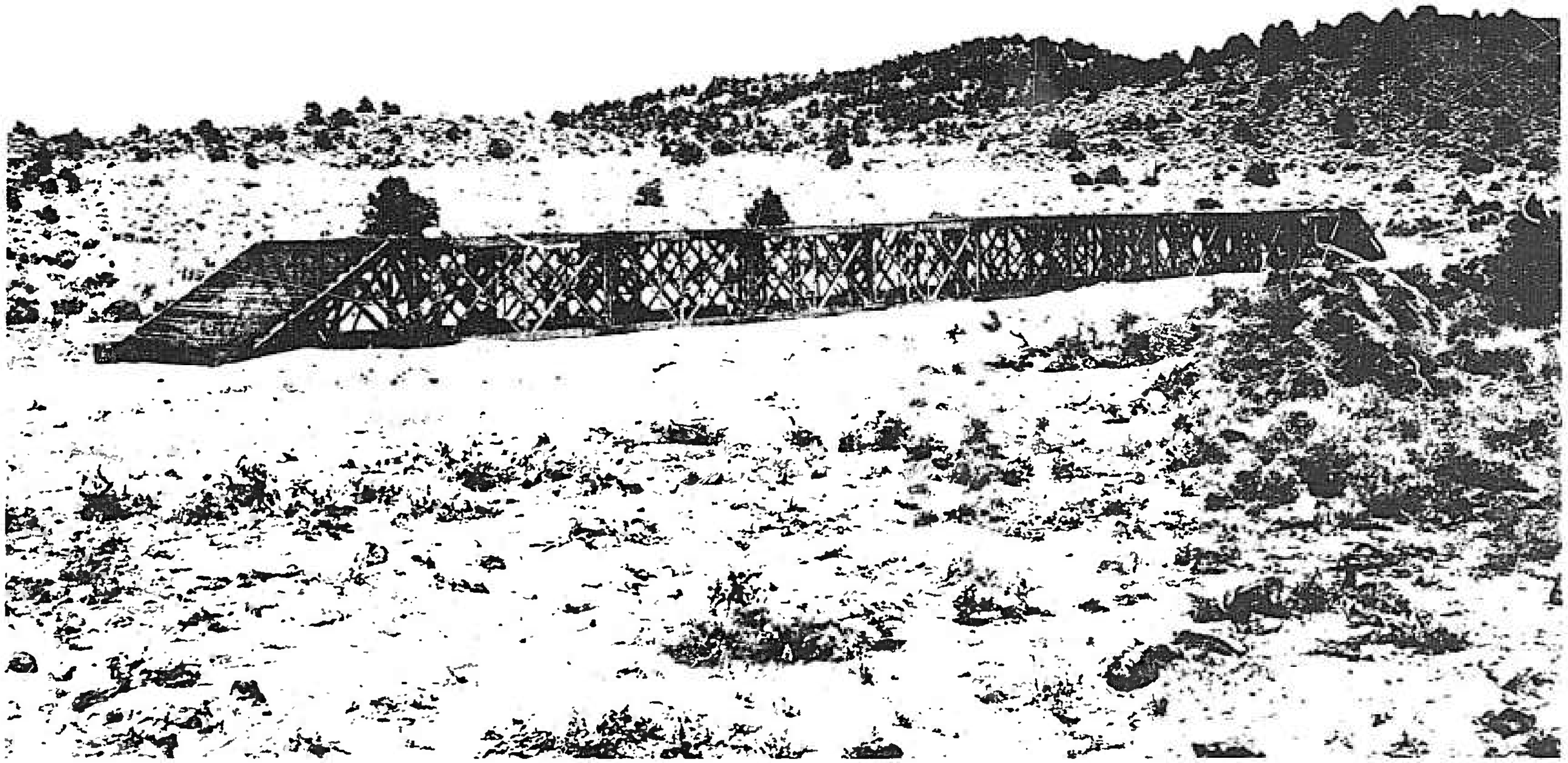

Fig. 19A. Target 7.

Fig. 20A. Target 5.

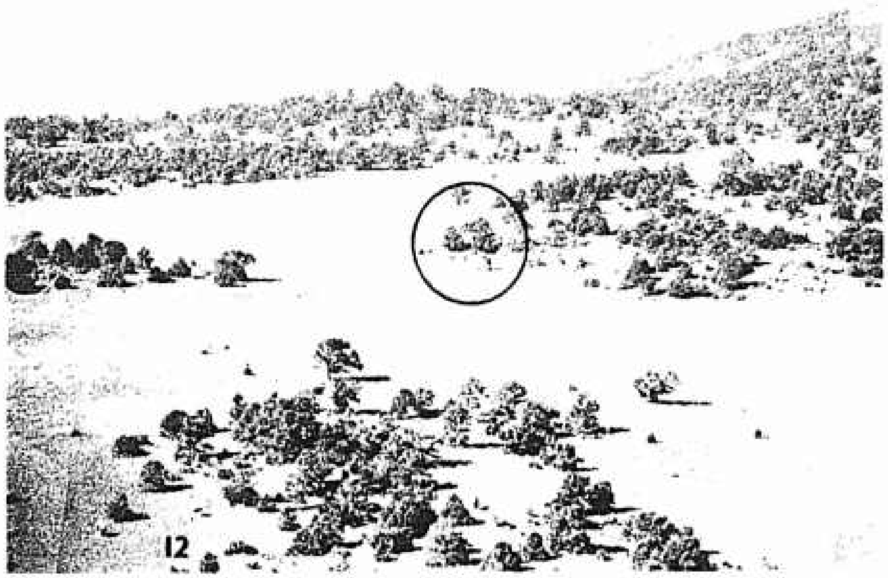

Fig. 21A. Targets 22 and 12.

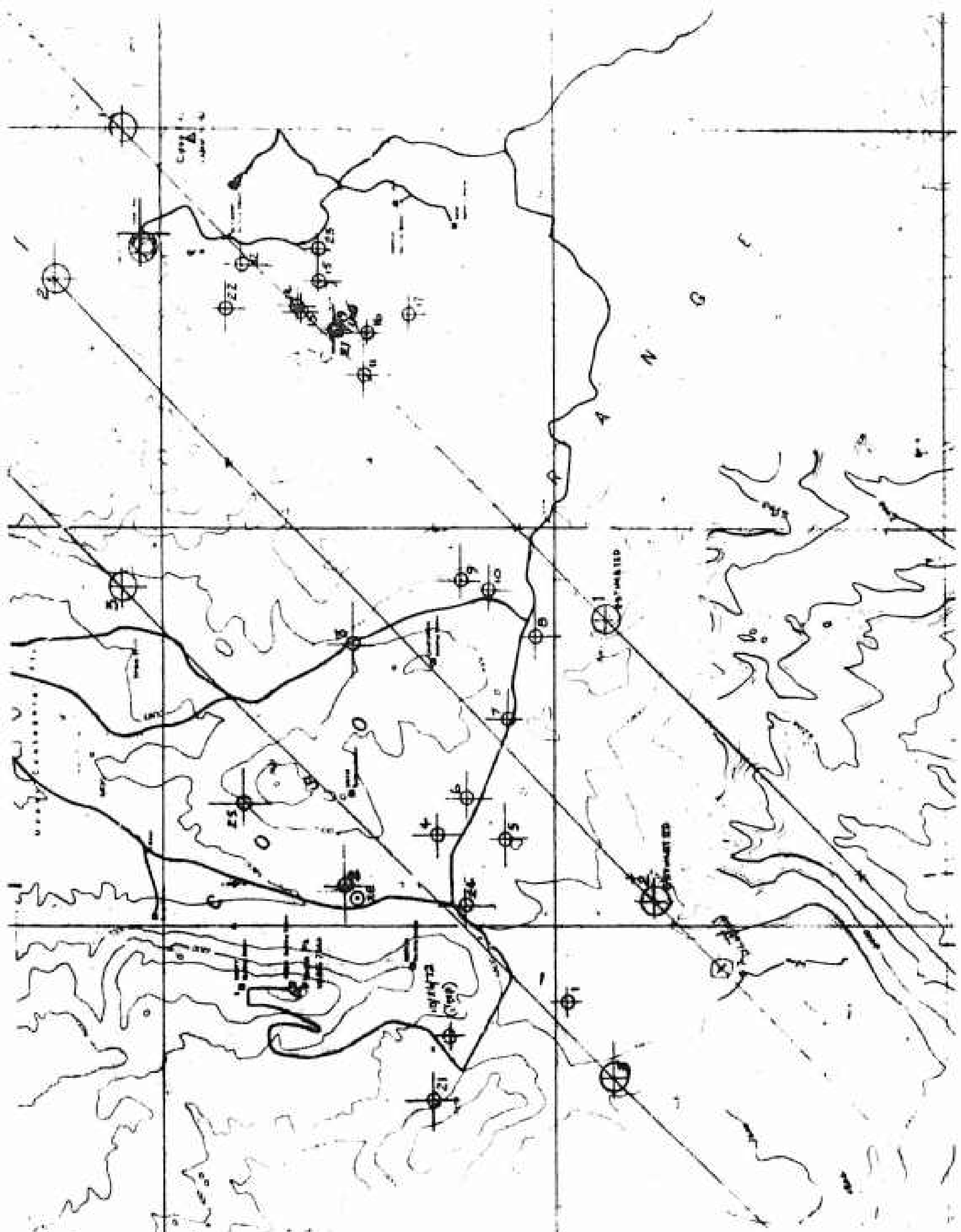

Fig. 22A. HELHAT I flight test area.

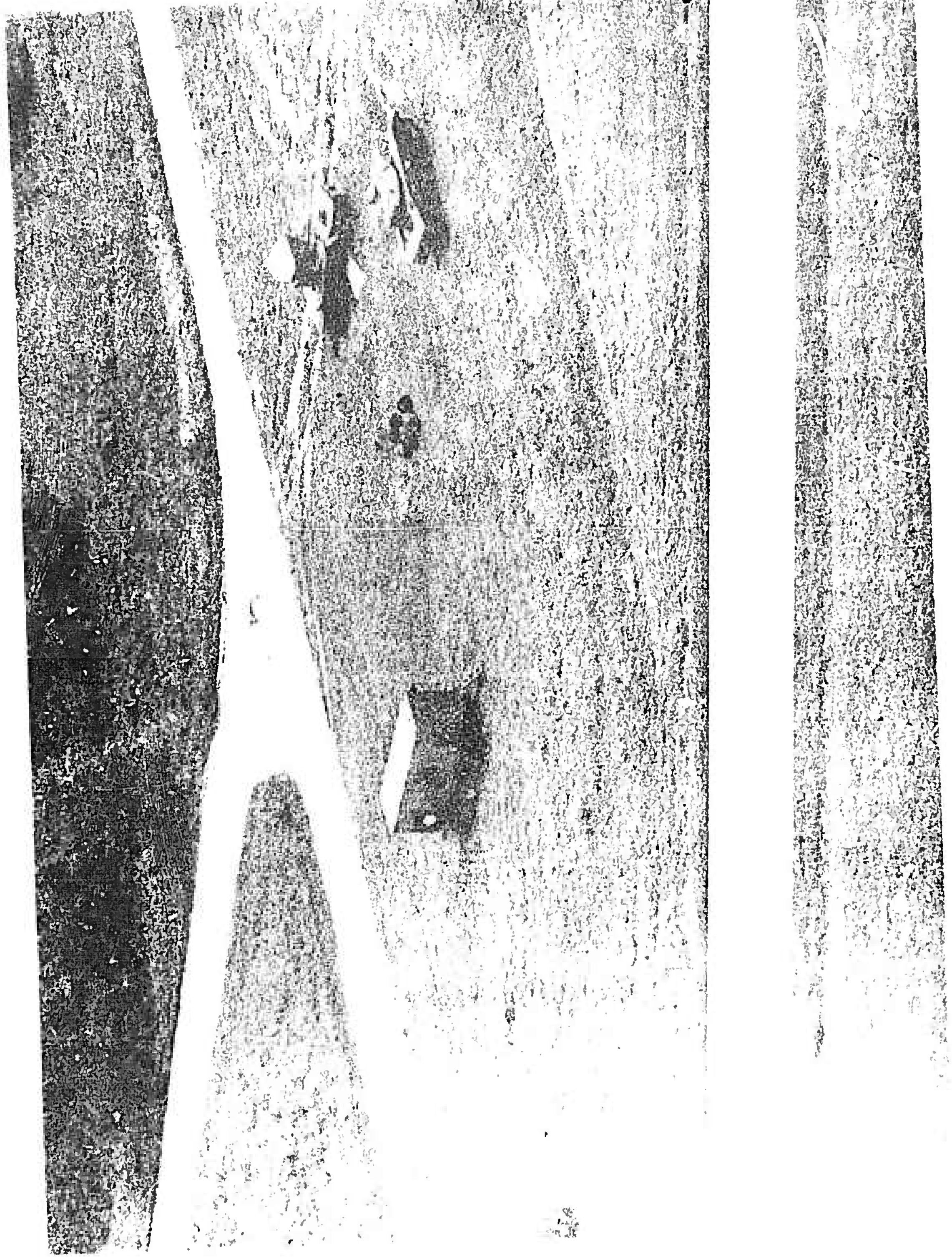

Fig. 23A. Target 1 low level.

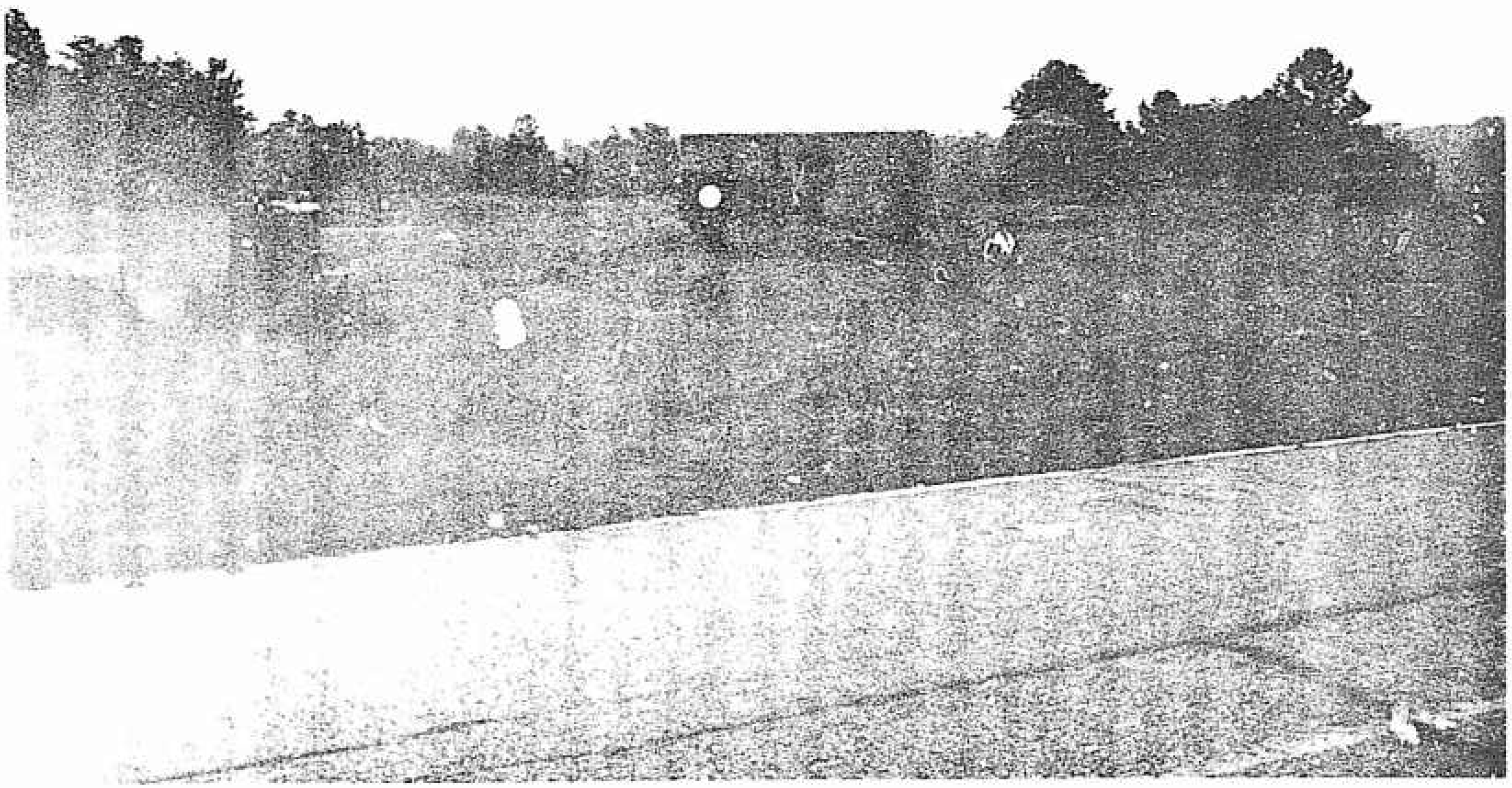

Fig. 24A. Target 1 at NOE altitude.

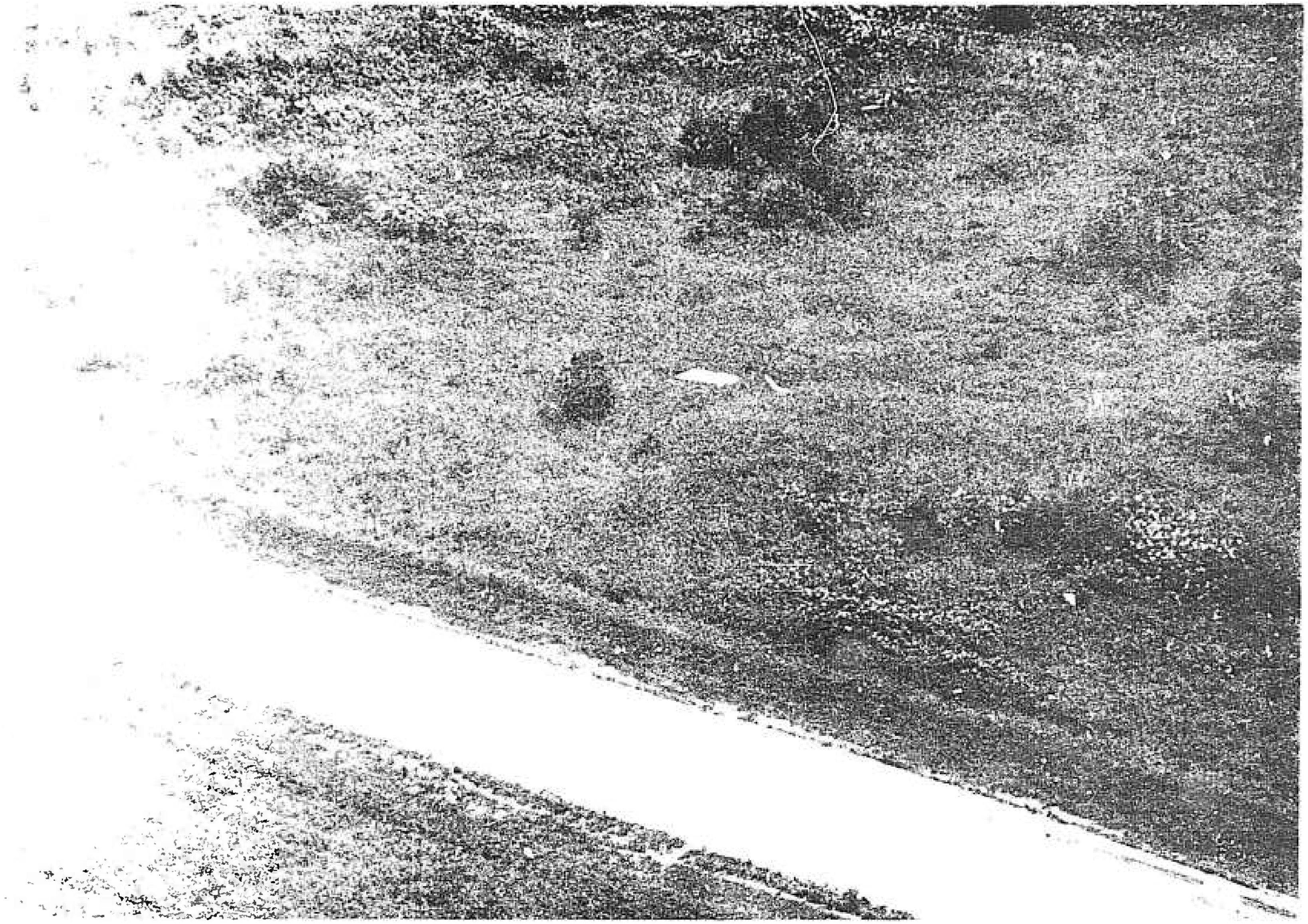

Fig. 25A. Target 2 low level

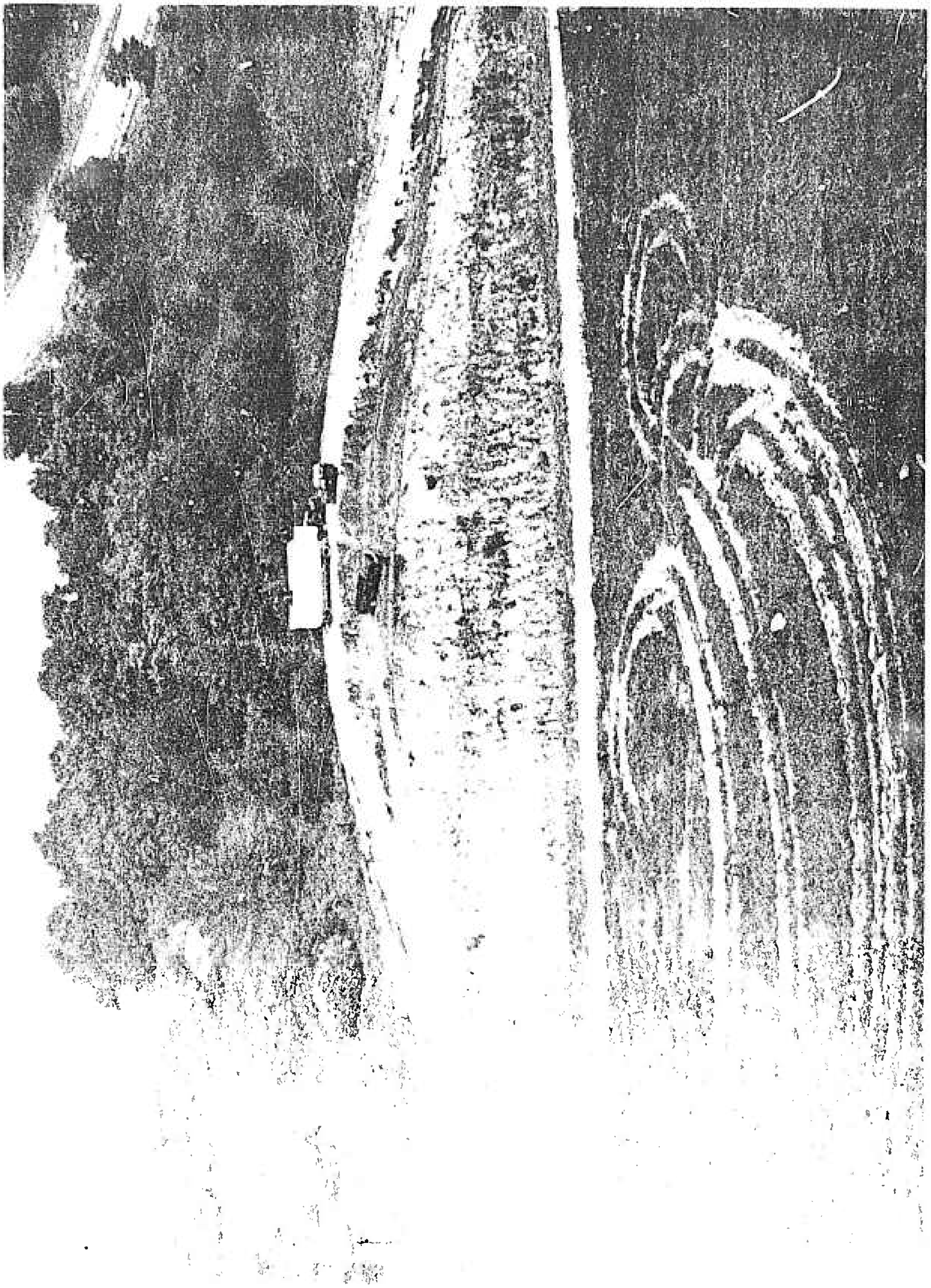

Fig. 26A. Target 3 low level.

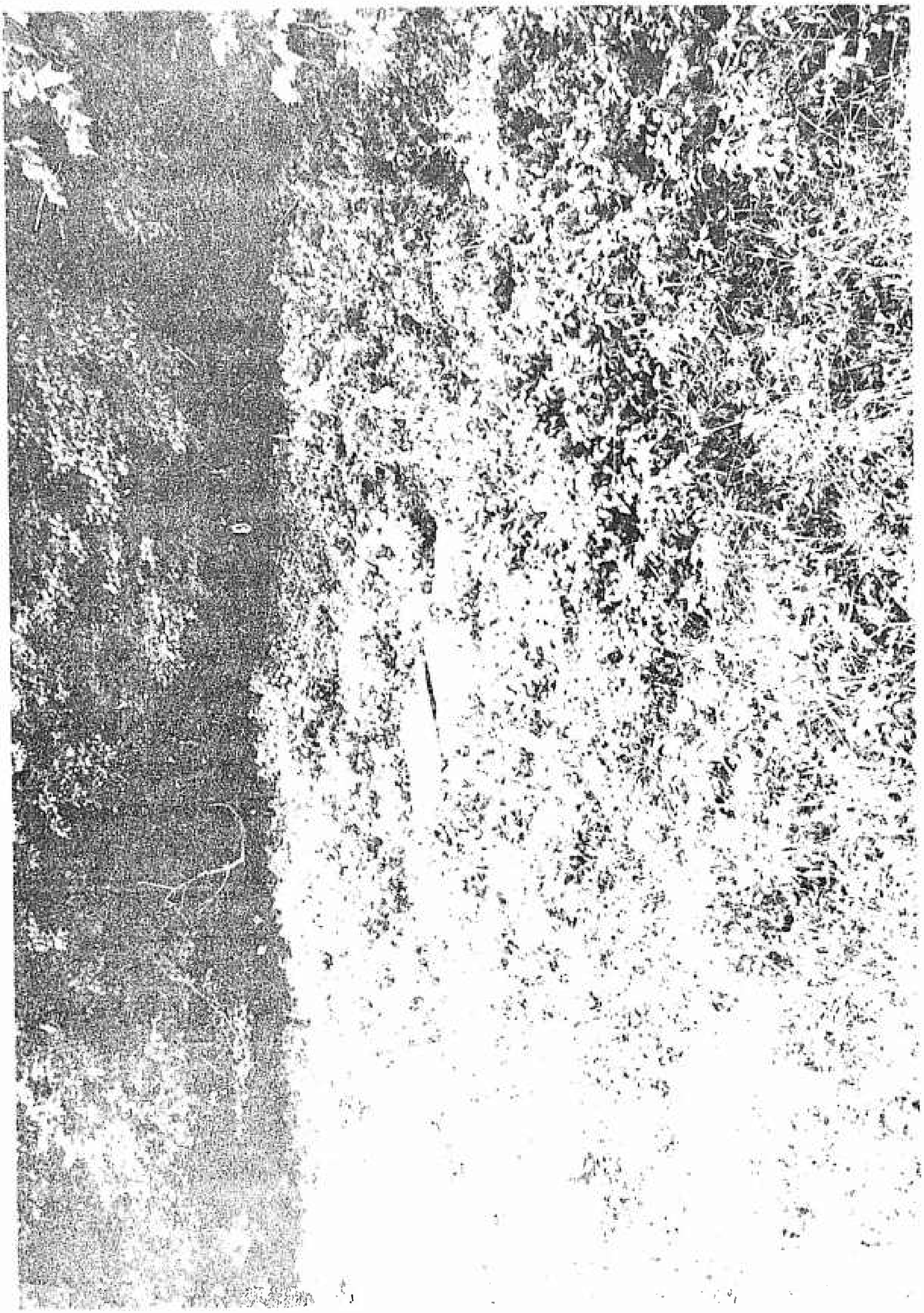

Fig. 27A. Target 4 at NOE altitude.

Fig. 28A. Target 5 at NOE altitude.

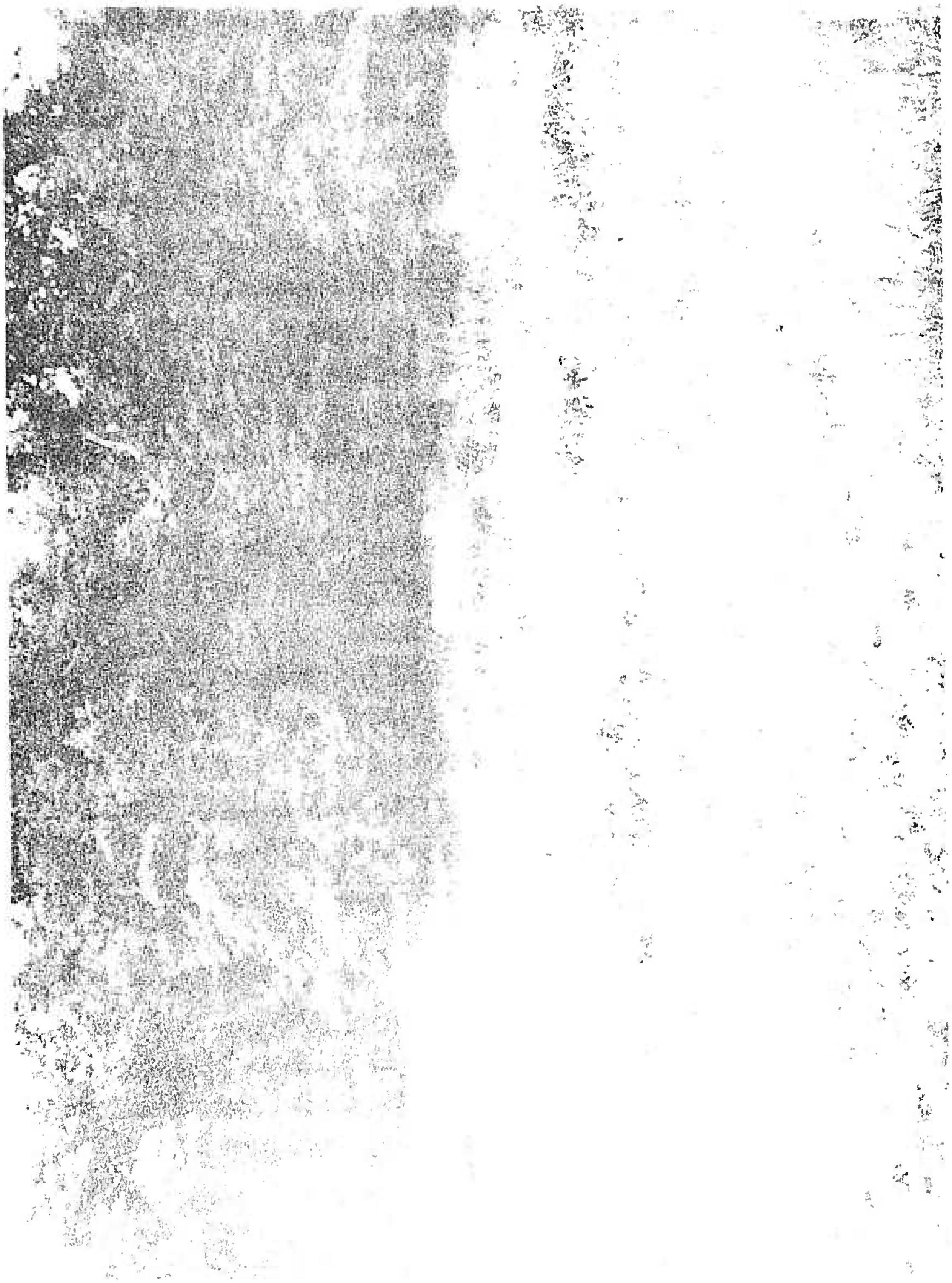

Fig. 29A. Target 6 at NOE altitude.

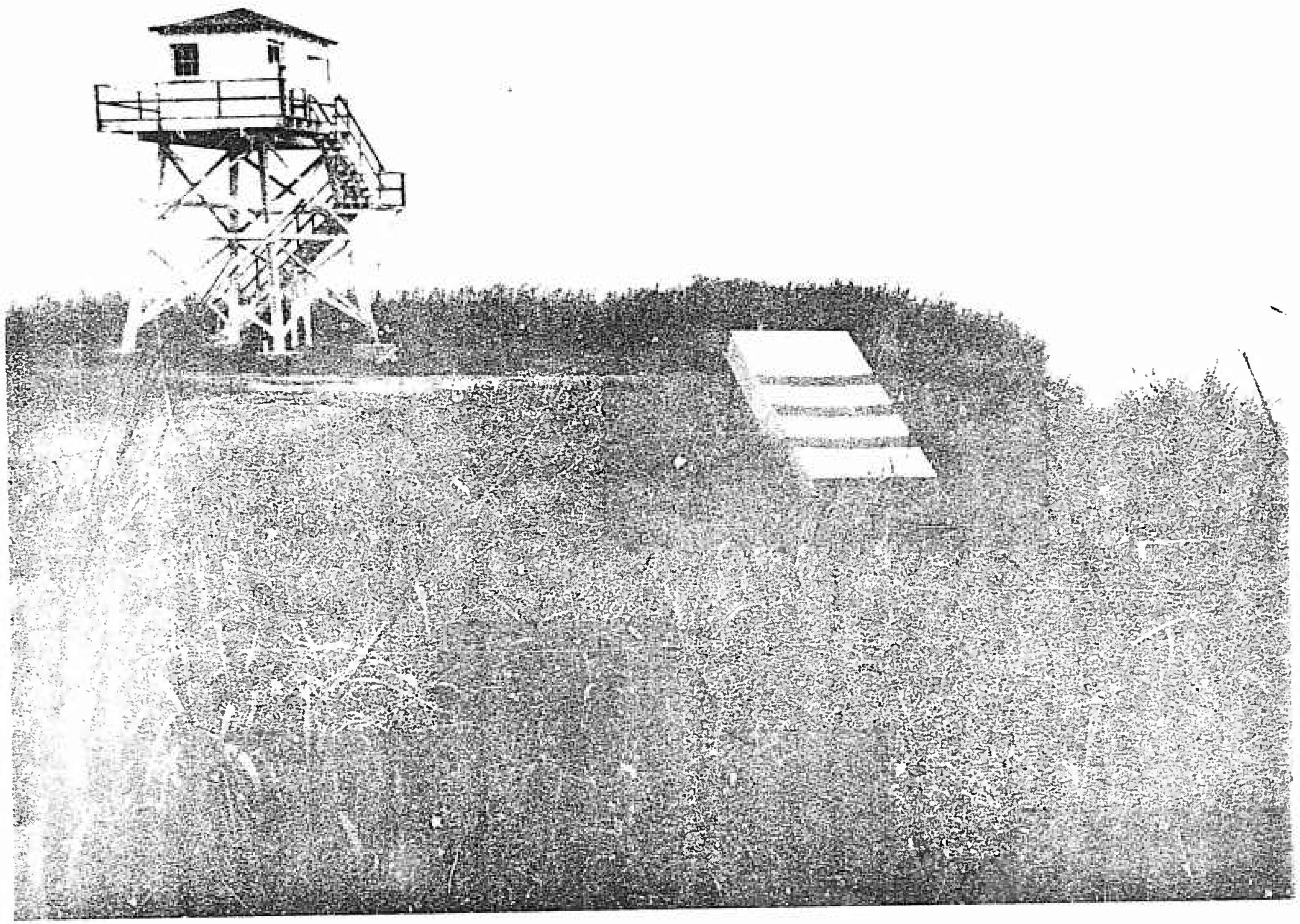

Fig. 30A. Target 7 at NOE altitude.

Fig. 31A. Target 8 at NOE altitude.

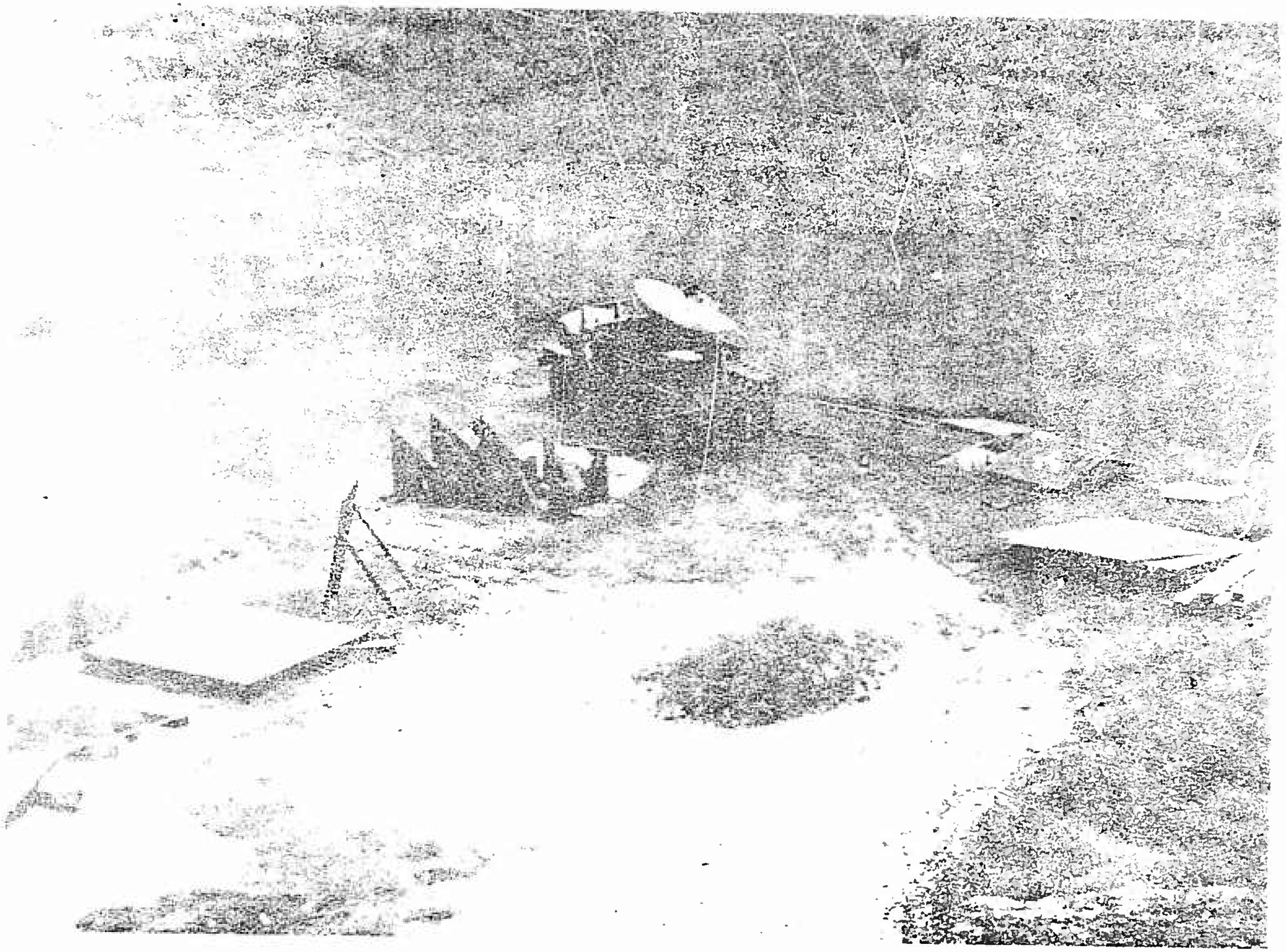

Fig. 32A. Target 9 at NOE altitude.

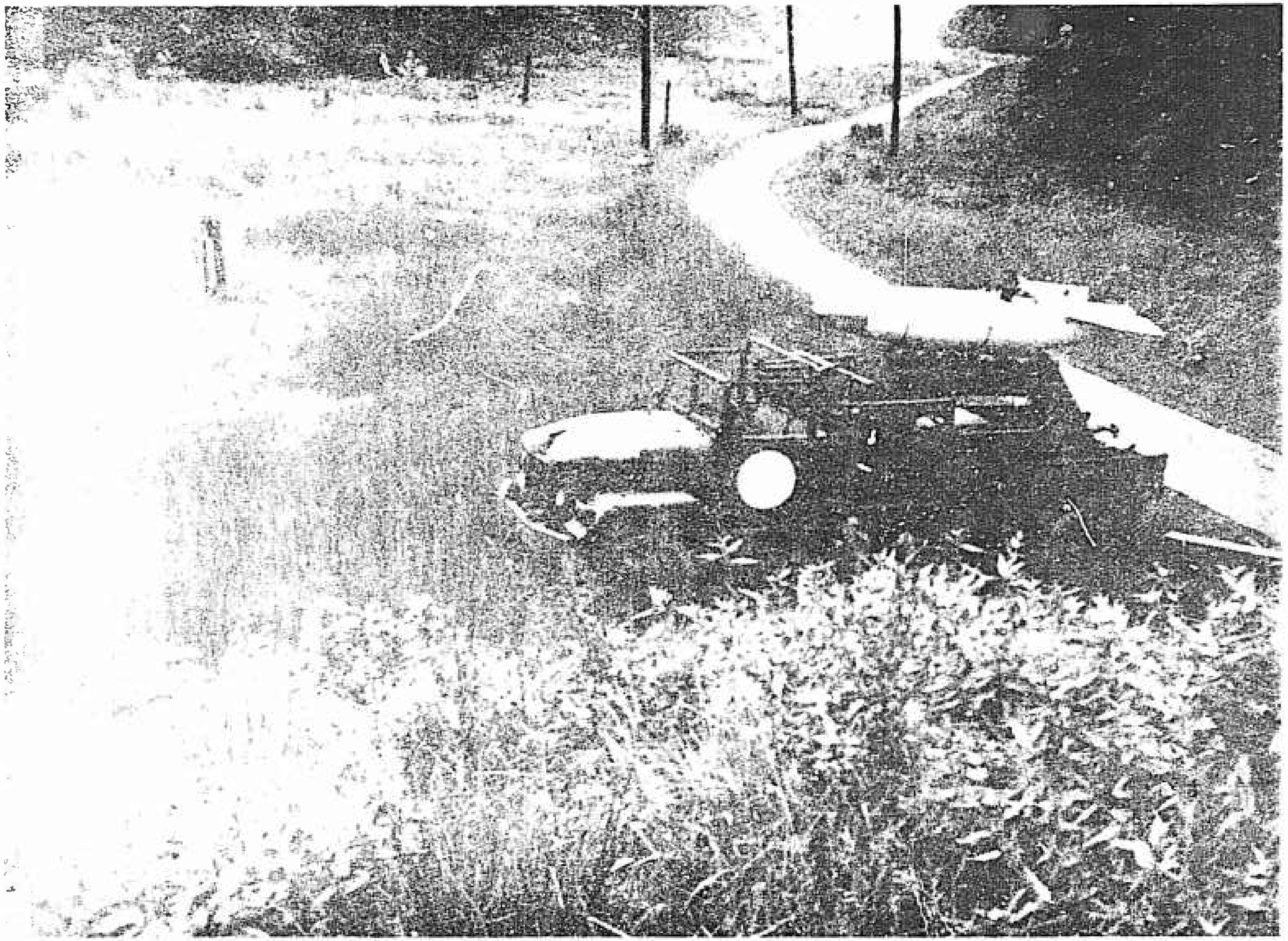

Fig. 33A. Target 11 at NOE altitude

Fig 34A. Target 12 at NOE altitude

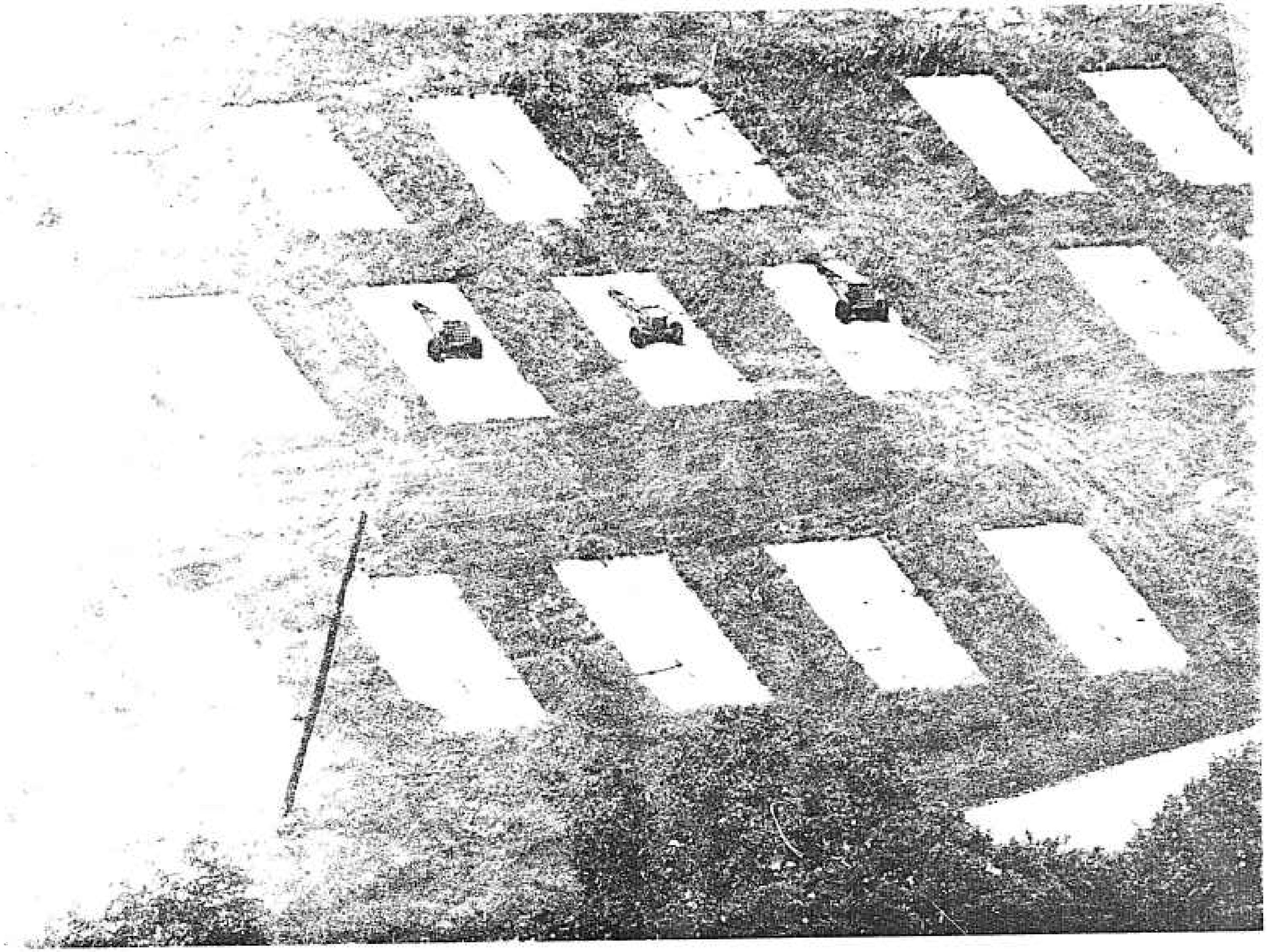

Fig. 35A. Target 13 low level.

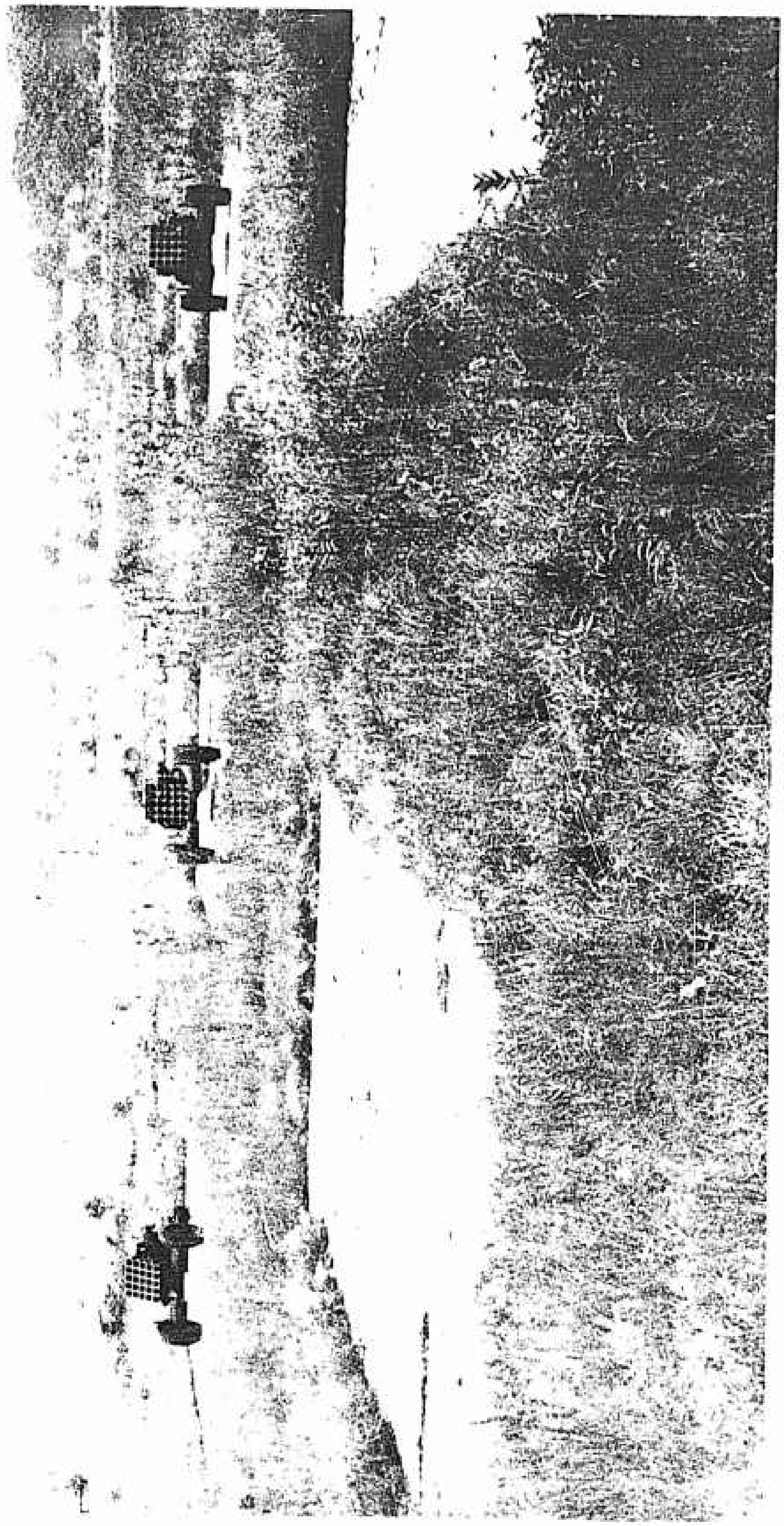

Fig. 36A. Target 13 at NOE altitude.

Fig. 37A Target 14 at NOE altitude—side view.

Fig. 38A. Target 14 at NOE altitude—front view.

Fig. 39A Target 15 low level

APPENDIX B

COSO RANGE PHOTOMETER READINGS

DEPARTMENT OF THE NAVY
NAVAL WEAPONS CENTER
CHINA LAKE, CALIFORNIA 93555

IN REPLY REFER TO
4073/GDE:1g
Reg. 4073-79-72
20 November 1972

From: G. D. Erdmann (Code 4073)
To: P. H. Amundson (Code 4073)

Subj: Luminance Readings and Contrast Computations for Target Acquisition

1. Target and target background brightness readings were obtained for the target acquisition portion of the helicopter target acquisition and delivery accuracy tests conducted on three Naval Weapons Center ranges during the latter part of October. All photometric brightness readings were made with a Spectra Pritchard Photometer which was ground based on Cinder, Coso, and Pinion Peaks while test flights were carried out in those areas. These luminance measurements were then used to calculate target contrast which is given by the following formula:

$$\text{Target contrast} = \frac{\text{Brightness target} - \text{Brightness background}}{\text{Brightness background}}$$

Since target contrast is thought to be a major factor in the helicopter scout's ability to acquire the target, these contrast computations will be tested in computer target detection models.

2. The Spectra Pritchard Photometer is a conical spot photometer which consists of a sensor that is pointed at the object to be measured and a meter which displays the brightness readings. The sensor weighs 9 pounds and is 3.5" x 6" x 18" in size. A telescopic viewing system with a normal focusing range from 5 feet to infinity is built into the sensor. A 2 arc minute (1/30°) mirror aperture was used for all luminance readings. A black circular spot in the field of view indicates the area of the object being measured. For example, if the line of sight to the target is 10,000 feet, a 2 arc minute aperture will record the light reflected from a circular area 5.8 feet in diameter. The photometer has the capability to measure brightness ranges from .0001 through 1 billion footlamberts (FL). The ranges encountered during the tests varied from about 100 FL to 12,000 FL.

3. Readings were obtained by two men--one to train the sensor and the other to read the meter and record the numbers. Since the photometer was based on the ground, it was usually easy to hold the sensor on fairly small targets. (An example of a small target is a tank viewed from 3050 meters). However, with a 30-40 knot wind, small targets were sometimes difficult to hold. Target and photometer positions were surveyed in before the tests started so that slant ranges could be computed. A Pro Products plum and level inclinometer was attached to the sensor to measure the downlook angle to the target. An airguide magnetic compass

attached to the sensor provided target bearing relative to the sensor.

4. The target acquisition test took place on the Coso range. Huey Cobras flew over the area on three selected flight paths at about 60 knots and 150 feet AGL. Each Huey had in it an observer whose job was to call out each target he saw and to estimate it's slant range and clock position. It had been planned to make brightness measurements from the air, but slippage of the tests due to bad weather and range problems caused this part of the test to be cancelled. It is important to note that air based readings would differ from ground based readings because of the differences in slant range, altitude, and bearing of the target. Often the target bearing relative to the aircraft varied from the target bearing relative to the position of the photometer by as much as 90°.

5. Photometric readings were taken about every hour that tests were in progress because of the brightness changes that occurred. The Cinder targets that were measured were two tanks, the Coso targets were a supply dump, an anti-aircraft gun, a tanker truck, an M-47 tank, and a duck, and the Pinion targets were a pickup and an area of personnel silhouettes. Figures 1 through 4 are pictures of the Coso targets which are circled in red. Two guns and two ducks are circled, but in both cases only the right gun and the right duck were measured. The readings that were obtained in addition to bearing, altitude, slant range, and visibility information can be found in Tables 1 through 13. Target contrast is calculated for the Cinder and Coso targets and the contrast ratios can be seen in Tables 14 through 24. Luminance abbreviations that were used in computing Cinder contrast ratios are given in Table 25 and the Coso abbreviations used are shown in Table 26.

G. D. Erdmann

G. D. ERDMANN

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Erickson, Lacy (4011)
Homer (4073)
Amundson (4) (4073)
Erdmann (4) (4073)
Gardner (6075)

(NOTE: Figures 1 through 13 and Tables 1 through 7 and 12 through 26 are not included)

TABLE 8. Photometer Readings from Coso Peak on October 24, 1972. Visibility estimated at 15 miles with slight haze and wind velocity of 30 knots.

Supply Dump

Bearing	260° magnetic
Slant Range	946 meters
Height of Photometer above Dump	99 meters

Time	0940	1050
Dump	1500	1600
Tree to left	900	800
Ground below	1250	1300

Anti-Aircraft Gun

Bearing	218° magnetic
Slant Range	1739 meters
Height of Photometer above Gun	152 meters

Time	0940	1050
Gun	430	900
Tree above	500	950
Sage to left	770	1200
Ground to right	1150	1400

Tanker Truck

Bearing	215° magnetic
Slant Range	1345 meters
Height of Photometer above Truck	141 meters

Time	0935	1050
Left side of truck	1550	1800
Ground to left	1150	1350
Rear of truck	180	650
Brush above	950	1250

TABLE 8. (Continued)

M47 Tank

Bearing		210° magnetic
Slant Range		956 meters
Height of Photometer above Tank		133 meters
Time	0935	1045
Turret	1450	1200
Ground to left	660	1000
Tree above	520	850
Shrub below	640	900

Duck

Bearing		195° magnetic
Slant Range		1625 meters
Height of Photometer above Duck		142 meters
Time	0930	1045
Side of duck	2200	2100
Front of duck	175	650
Ground below	640	1300
Tree above	280	900

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TABLE 9. Photometer Readings from Coso Peak on October 25, 1972. Visibility estimated at 40-50 miles with clear sky.

Supply Dump

Bearing	260° magnetic
Slant Range	946 meters
Height of Photometer above Dump	99 meters

Time	0920	1035	1210	1335	1500	1600
Dump	1400	1100	950	950	360	400
Tree to left	700	520	360	250	200	210
Ground below	1350	1100	1000	700	480	430

Anti-Aircraft Gun

Bearing	218° magnetic
Slant Range	1739 meters
Height of Photometer above Gun	152 meters

Time	0920	1030	1205	1330	1500	1600
Gun	420	360	290	260	330	420
Tree above	540	500	420	380	360	440
Sage to left	720	700	640	600	570	620
Ground to right	1150	1100	1000	810	750	740

Tanker Truck

Bearing	215° magnetic
Slant Range	1345 meters
Height of Photometer above Gun	141 meters

Time	0915	1030	1205	1330	1500	1600
Left side of truck	1500	1900	2150	2200		1500
Ground to left	1050	1050	950	850	800	660
Rear of truck	200	170	190	200	260	370
Brush above	1100	1050	780	660	640	600

TABLE 9. (Continued)

M47 Tank

Bearing 210° magnetic
Slant Range 956 meters
Height of Photometer above Tank 133 meters

Time	0915	1030	1200	1330	1500	1600
Turret	1450	1350	970	235	260	300
Ground to left	900	680	640	560	520	500
Tree above	520	500	470	410	420	480
Shrub below	540	550	520	400	280	330

Duck

Bearing 195° magnetic
Slant Range 1625 meters
Height of Photometer above Duck 142 meters

Time	1910	1025	1200	1325	1500	1600
Side of duck	2100	2100	1350	420	430	420
Front of duck	140	165	200	260	320	340
Ground below	660	700	740	800	720	650
Tree above	440	460	430	460	400	360

TABLE 10. (Continued)

M47 Tank

Bearing 210° magnetic
Slant Range 956 meters
Height of Photometer above Tank 133 meters

Time	0900	1005	1100	1205	1300	1405	1445	1520	1555	1620
Turret	1130	1110	1050	520	470	440	480	290	210	175
Ground to left	670	800	790	650	610	580	720	350		210
Tree above	540	570	570	460	580	570	580	300	200	160
Shrub below	590	600	620	510	590	510	570	310	210	170

Duck

Bearing 195° magnetic
Slant Range 1625 meters
Height of Photometer above Tank 142 meters

Time	0900	1005	1100	1205	1300	1400	1445	1525	1555	1620
Side of duck	1600	1830	1400	1050	810	680	770	380	290	230
Front of duck	260	310	410	410	560	570	630	320	200	155
Ground below	680	810	870	790	1120	680	1100	440	220	280
Tree above	500	240	470	520	680	930	690	330	340	175

TABLE 10. Photometer Readings from Coso Peak on October 26, 1972.
Visibility estimated at 40 miles with slight haze.

<u>Supply Dump</u>

Bearing 260° magnetic
Slant Range 946 meters
Height of Photometer above Dump 99 meters

Time	0910	1000	1105	1210	1305	1410	1440	1520	1600	1625
Dump	380	600	1760	1500	680	450	390	250	170	145
Tree to left	690	660	630	430	330	280	240	180	150	115
Ground below	1260	1240	1030	450	250	220	230	250	160	125
Sage to left	1250	1300	1340	960	670	610	460	330	250	210

<u>Anti-Aircraft Gun</u>

Bearing 218° magnetic
Slant Range 1739 meters
Height of Photometer above Gun 152 meters

Time	0910	1000	1105	1210	1305	1405	1445	1520	1660	1620
Gun	520	490	500	480	450	490	470	280	200	175
Tree above	580	570	580	520	410	510	480	280	190	160
Sage to left	750	820	860	790	620	690	720	410	270	235
Ground to right	840	1060	1120	820	710	800	890	460	310	260

<u>Tanker Truck</u>

Bearing 215° magnetic
Slant Range 1345 meters
Height of Photometer above Gun 141 meters

Time	0905	1005	1100	1210	1305	1405	1445	1520	1600	1620
Left side of truck	1300	1630	1750	1550	1600	2050	2200	740	410	250
Ground to left		1110	1160	870	700	790	930	470	310	260
Rear of truck	350	230	260	290	320	400	440	280	170	135
Brush above	790	1000	940	780	680	750	910	460	300	265

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TABLE 11. Photometer Readings from Coso Peak on October 27, 1972. Visibility estimated at 10 miles with heavy overcast.

Supply Dump

Bearing	260° magnetic
Slant Range	946 meters
Height of Photometer above Dump	99 meters

Time	0925	1015	1115	1225	1325
Dump	580	950	440	150	220
Tree to left	620	700	340	140	180
Ground below	900	900	380	180	230
Sage to left	1300	1240	640	225	320

Anti-aircraft Gun

Bearing	218° magnetic
Slant Range	1739 meters
Height of Photometer above Gun	552 meters

Time	0950	1015	1115	1220	1325
Gun	420	580	330	160	340
Tree above	430	640	330	170	340
Sage to left	570	800	400	200	430
Ground to right	690	1050	450	220	490

Tanker Truck

Bearing	215° magnetic
Slant Range	1345 meters
Height of Photometer above Truck	141 meters

Time	0920	1015	1110	1220	1320
Left side of truck	680	1650	600	280	470
Ground to left	520	1070	480	210	400
Rear of truck	240	400	290	150	240
Brush above	600	1000	450	220	400

TABLE 11. (Continued)

M47 Tank

Bearing	210° magnetic
Slant Range	956 meters
Height of Photometer above Tank	133 meters

Time	0920	1010	1110	1220	1320
Turret	400	1150	560	160	230
Ground to left	330	850	500	160	250
Tree above	300	590	420	160	220
Shrub below	300	650	440	150	220

Duck

Bearing	195° magnetic
Slant Range	1625 meters
Height of Photometer above Duck	142 meters

Time	0920	1010	1110	1220	1320
Side of duck	1550	1550	560	220	340
Front of duck	370	480	400	180	250
Ground below	760	920	570	250	370
Tree above	500	640	420	200	290

APPENDIX C

RESULTS OF MULTIPLE REGRESSION ANALYSES AND ANOVAS

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                                                                          10 JUL 74 PAGE    1
JULY 11,74  BRLESC  FORTRAN 2 AND 4                                       CT  0..42
*     HE 415 LILA --LINC  BLDG 328 X4549                                                    *


MULTIPLE REGRESSION
SUBPROG. NO.=        1                                           MULTIPLE REGRESSION
NOS. PER EQ.=       28                                           SUBPROG. NO.=        1
NO. OF TERMS=       21                                           NOS. PER EQ.=       28
     RUN    1 - 1                                                NO. OF TERMS=       21
NO. OF INPUT LINES=          281                                      RUN    1 - 1
CURR.ERMS= 0.99301245E 02     ADD TERM    10                     NO. OF INPUT LINES=         281
CURR.ERMS= 0.18159932E 01     ADD TERM     6                     MEAN= 0.99284698E 02
CURR.ERMS= 0.17257441E 01     ADD TERM    21                     S. DEV.= 0.18159932E 01
CURR.ERMS= 0.17143348E 01     ADD TERM    13
CURR.ERMS= 0.17006532E 01     ADD TERM     5
CURR.ERMS= 0.16787012E 01     ADD TERM     7

T1= 0.16450000E 01 T2= 0.16450000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    5    6    7   10   13   21

COEFFICIENTS
-0.12053175E 00 -0.27433126E-02 -0.14191583E-02  0.10138250E 03  0.38357405E-02
-0.32740197E-01

 0.16703796E 01=ERMS           0.16703796E 01=RE.ERMS

SIGMAS
 0.39917806E-01  0.37540850E-03  0.73218337E-03  0.46147472E 00  0.12041841E-02
 0.12488286E-01

T'S
-0.30194985E 01 -0.73075398E 01 -0.19382553E 01  0.21969242E 03  0.31853438E 01
-0.26216727E 01

 0.39235003E 00=RHO            0.15393855E 00=RHO**2
```

```
MULTIPLE REGRESSION                                          MULTIPLE REGRESSION
SUBPROG. NO.=       2                                        SUBPROG. NO.=       2
NOS. PER EQ.=      28                                        NOS. PER EQ.=      28
NO. OF TERMS=      23                                        NO. OF TERMS=      23
      RUN   1 - 2                                                  RUN   1 - 2
NO. OF INPUT LINES=        120                               NO. OF INPUT LINES=        120
CURR.ERMS= 0.99302935E 02     ADD TERM   12                  MEAN= 0.99302333E 02
CURR.ERMS= 0.34702271E 00     ADD TERM   10                  S. DEV.= 0.34702271E 0
CURR.ERMS= 0.32558506E 00     ADD TERM    8
CURR.ERMS= 0.29832105E 00     ADD TERM    7
CURR.ERMS= 0.29417946E 00     ADD TERM    4
CURR.ERMS= 0.29219473E 00     ADD TERM    6

T1= 0.16580000E 01 T2= 0.16580000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    4    6    7    8   10   12

COEFFICIENTS
 0.26951818E-01 -0.23705921E-02  0.33460398E-02 -0.61255962E-03  0.81341814E-03
 0.98961082E 02

 0.28956604E 00=ERMS             0.28956604E 00=RE.ERMS

SIGMAS
 0.14044198E-01  0.13469662E-02  0.12456602E-02  0.13964394E-03  0.11589839E-03
 0.95239473E-01

T'S
 0.19190713E 01 -0.17599491E 01  0.26861577E 01 -0.43865821E 01  0.70183730E 01
 0.10390763E 04

 0.55111447E 00=RHO              0.30372716E 00=RHO**2
```

```
MULTIPLE REGRESSION                                 MULTIPLE REGRESSION
SUBPROG. NO.=        3                              SUBPROG. NO.=        3
NOS. PER EQ.=       28                              NOS. PER EQ.=       28
NO. OF TERMS=       23                              NO. OF TERMS=       23
      RUN    1 - 3                                        RUN    1 - 3
NO. OF INPUT LINES=         247                     NO. OF INPUT LINES=        247
CURR.ERMS= 0.99298462E 02     ADD TERM   10         MEAN= 0.99279717E 02
CURR.ERMS= 0.19332624E 01     ADD TERM    6         S. DEV.= 0.19332624E 01
CURR.ERMS= 0.18247825E 01     ADD TERM   22
CURR.ERMS= 0.18066927E 01     ADD TERM   23
CURR.ERMS= 0.17944042E 01     ADD TERM    5
CURR.ERMS= 0.17799482E 01     ADD TERM   13
CURR.ERMS= 0.17560208E 01     ADD TERM    7

T1= 0.16450000E 01 T2= 0.16450000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    5    6    7   10   13   22   23

COEFFICIENTS
-0.12801666E 00 -0.31552097E-02 -0.13468881E-02  0.10138180E 03  0.40868140E-02
 0.57093034E-03 -0.38375957E-01

 0.17499220E 01=ERMS           0.17499220E 01=RE.ERMS

SIGMAS
 0.44330091E-01  0.41803847E-03  0.82231473E-03  0.51829865E 00  0.13616152E-02
 0.28791950E-03  0.15155772E-01

T'S
-0.28878050E 01 -0.75476540E 01 -0.16379229E 01  0.19560499E 03  0.30014457E 01
 0.19829513E 01 -0.25321017E 01

 0.42505977E 00=RHC            0.18067581E 00=RHC**2
```

```
MULTIPLE REGRESSICN                                        MULTIPLE REGRESSION
SUBPROG. NO.=        4                                     SUBPROG. NO.=        4
NOS. PER EQ.=       28                                     NOS. PER EQ.=       28
NO. OF TERMS=       25                                     NO. OF TERMS=       25
      RUN    1 - 4                                               RUN    1 - 4
NO. OF INPUT LINES=         11C                            NO. OF INPUT LINES=         11C
CURR.ERMS= 0.99316906E 02      ADD TERM    12              MEAN= 0.99316273E 02
CURR.ERMS= 0.35625437F CC      ADD TERM    25              S. DEV.= 0.35625437E 0
CURR.ERMS= 0.33456526F CC      ADD TERM    14
CURR.ERMS= C.32808747E CC      ADD TERM    1C
CURR.ERMS= 0.32251836E CC      ADD TERM     8
CURR.ERMS= 0.29641747E CC   REMOVE TERM    14
CURR.ERMS= C.29635353E CC      ADD TERM     7
CURR.ERMS= 0.29219184E CC      ADD TERM     6
CURR.ERMS= 0.28778454E CC      ADD TERM     4
CURR.ERMS= 0.28401404E C0   REMOVE TERM    25
CURR.ERMS= 0.28305240F C0      ADD TERM    15
CURR.ERMS= 0.27983463E CC      ADD TERM     1
CURR.ERMS= 0.27308837F CC      ADD TERM     3
CURR.ERMS= 0.26668408F CC      ADD TERM     5

T1= 0.16580000E 01 T2= C.16580000E C1 TA= C.OCCCCCCCOE CC TR= C.00C00000E 00

TERMS
    1    3    4    5    6    7    8   1C   12   15

COEFFICIENTS
 0.15970830E-02 -0.19233203E-03  C.21514810E CC  0.32243C17E-01 -0.36564039E-02
 0.47773425E-02 -0.34189191E-03  C.75118403E-03  C.97554C42E 02  0.16021651E-02

 0.26190624E 0C=ERMS          C.2619C624E 00=RE.ERMS

SIGMAS
 0.42572124E-03  0.59099345E-04  C.41560159E-01  0.14843242E-01  0.13465060E-02
 0.12642025E-02  0.21184316E-03  C.14781164E-03  0.34581032E 00  0.43538574E-03

T'S
 0.37514759E 01 -0.32543851E 01  C.51767873E C1  0.21722354E 01 -0.27154754E 01
 0.37789377E 01 -0.16138917E C1  C.50820356E 01  C.28210275E C3  0.36798750E 01

 0.67788668E 0C=RHC           C.45953035E 0C=RHC**2
```

```
MULTIPLE REGRESSION                                   MULTIPLE REGRESSION
SUBPROG. NO.=        1                                SUBPROG. NO.=        1
NOS. PER EQ.=       28                                NOS. PER EQ.=       28
NO. OF TERMS=       21                                NO. OF TERMS=       21
      RUN    2 - 1                                          RUN    2 - 1
NO. OF INPUT LINES=          76                       NO. OF INPUT LINES=          76
CURR.ERMS= 0.99276318E 02     ADD TERM     4          MEAN= 0.99275658E 02
CURR.ERMS= 0.36450271E 00     ADD TERM     8          S. DEV.= 0.36450271E 0
CURR.ERMS= 0.33643479E 00     ADD TERM     6
CURR.ERMS= 0.31179146E 00     ADD TERM     7
CURR.ERMS= 0.30259825E 00     ADD TERM    13
CURR.ERMS= 0.29211188E 00     ADD TERM     1
CURR.ERMS= 0.27610004E 00     ADD TERM     3

T1= 0.16580000E 01 T2= 0.16580000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    1    3    4    6    7    8   13

COEFFICIENTS
 0.16365547E-02 -0.28066219E-03  0.98237883E 02 -0.82302404E-03 -0.13555159E-02
 0.10202972E-02  0.30644865E-02

 0.27336651E 00=ERMS             0.27336651E 00=RE.ERMS

SIGMAS
 0.50247106E-03  0.18090568E-03  0.27379606E 00  0.19345819E-03  0.37608485E-03
 0.16215677E-03  0.72438636E-03

T'S
 0.32570127E 01 -0.15514283E 01  0.35879948E 03 -0.42542735E 01 -0.36042822E 01
 0.62920421E 01  0.42304586E 01

 0.66147058E 00=RHC              0.43754333E 00=RHC**2
```

```
MULTIPLE REGRESSION
SUBPROG. NO.=        2
NOS. PER EQ.=       28
NO. OF TERMS=       23
     RUN   2 - 2
NO. OF INPUT LINES=          76
CURR.ERMS= 0.99276318E 02     ADD TERM    4
CURR.ERMS= 0.36450271E 00     ADD TERM   10
CURR.ERMS= 0.33643479E 00     ADD TERM    7
CURR.ERMS= 0.30671036E 00     ADD TERM    8
CURR.ERMS= 0.29289461E 00     ADD TERM    6

MULTIPLE REGRESSION
SUBPROG. NO.=        2
NOS. PER EQ.=       28
NO. OF TERMS=       23
     RUN   2 - 2
NO. OF INPUT LINES=          76
MEAN= 0.99275658E 02
S. DEV.= 0.36450271E 00

T1= 0.16580000E 01 T2= 0.16580000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    4    6    7    8   10

COEFFICIENTS
 0.98838832E 02 -0.46700482E-02  0.65209546E-02 -0.63094799E-03  0.96798284E-03

 0.28064818E 00=ERMS           0.28064818E 00=RE.ERMS

SIGMAS
 0.99789671E-01  0.17143456E-02  0.15395315E-02  0.18310929E-03  0.15356732E-03

T'S
 0.99047157E 03 -0.27240996E 01  0.42356746E 01 -0.34457455E 01  0.63033128E 01

 0.63810650E 00=RHC            0.40717991E 00=RHC**2
```

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                                                                        10 JUL 74 PAGE    1


MULTIPLE REGRESSION                                      MULTIPLE REGRESSION
SUBPROG. NO.=       3                                     SUBPROG. NO.=       3
NOS. PER EQ.=      28                                     NOS. PER EQ.=      28
NO. OF TERMS=      23                                     NO. OF TERMS=      23
      RUN   2 - 3                                               RUN   2 - 3
NO. OF INPUT LINES=         75                            NO. OF INPUT LINES=        75
CURR.ERMS= 0.99278135E 02     ADD TERM    4               MEAN= 0.99277467E 02
CURR.ERMS= 0.36661377E 00     ADD TERM    8               S. DEV.= 0.36661377E [illegible]
CURR.ERMS= 0.33871817E 00     ADD TERM    6
CURR.ERMS= 0.31393181E 00     ADD TERM    7
CURR.ERMS= 0.30452822E 00     ADD TERM   13
CURR.ERMS= 0.29325817E 00     ADD TERM    1
CURR.ERMS= 0.27803199E 00     ADD TERM    3

T1= 0.16580000E 01 T2= 0.16580000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    1    3    4    6    7    8   13

COEFFICIENTS
 0.16129194E-02 -0.28389033E-03  0.98251849E 02 -0.82281299E-03 -0.13755957E-02
 0.10190827E-02  0.30731706E-02

 0.27521516E 00=ERMS           0.27521516E 00=RE.ERMS

SIGMAS
 0.51306849E-03  0.18250436E-03  0.28025497E 00  0.19476796E-03  0.38555675E-03
 0.16331267E-03  0.72996371E-03

T'S
 0.31436727E 01 -0.15555263E 01  0.35058022E 03 -0.42245808E 01 -0.35678165E 01
 0.62400714E 01  0.42100321E 01

 0.66064883E 00=RHO            0.43645688E 00=RHO**2
```

```
                                                                     10 JUL 74 PAGE     1

MULTIPLE REGRESSION                                       MULTIPLE REGRESSION
SUBPROG. NO.=       4                                     SUBPROG. NO.=       4
NOS. PER EQ.=      28                                     NOS. PER EQ.=      28
NO. OF TERMS=      25                                     NO. OF TERMS=      25
      RUN   2 - 4                                               RUN   2 - 4
NO. OF INPUT LINES=        75                             NO. OF INPUT LINES=        75
CURR.ERMS= 0.99278135E 02     ADD TERM    4               MEAN= 0.99277467E 02
CURR.ERMS= 0.36661377E 00     ADD TERM   10               S. DEV.= 0.36661377E 00
CURR.ERMS= 0.33871817E 00     ADD TERM    7
CURR.ERMS= 0.30855522E 00     ADD TERM    8
CURR.ERMS= 0.29488005E 00     ADD TERM    6

T1= 0.16580000E 01 T2= 0.16580000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    4     6     7     8    10

COEFFICIENTS
 0.98839986E 02 -0.49178153E-02  0.65457298E-02 -0.64309242E-03  0.98346591E-03

 0.28207442E 00=ERMS            0.28207442E 00=RE.ERMS

SIGMAS
 0.10032020E 00  0.17847186E-02  0.15480541E-02  0.18544624E-03  0.15706004E-03

T'S
 0.98524511E 03 -0.27555131E 01  0.42283600E 01 -0.34678105E 01  0.62617194E 01

 0.63876140E 00=RHO             0.40801613E 00=RHO**2
```

```
MULTIPLE REGRESSION                                                MULTIPLE REGRESSION
SUBPROG. NO.=        1                                             SUBPROG. NO.=        1
NOS. PER EQ.=       28                                             NOS. PER EQ.=       28
NO. OF TERMS=       21                                             NO. OF TERMS=       21
       RUN   3 - 1                                                        RUN   3 - 1
NO. OF INPUT LINES=          205                                   NO. OF INPUT LINES=         205
CURR.ERMS= 0.99310485E 02     ADD TERM   10                        MEAN= 0.99288049E 02
CURR.ERMS= 0.21160215E 01     ADD TERM    6                        S. DEV.= 0.21160215E 01
CURR.ERMS= 0.19700250E 01     ADD TERM   13
CURR.ERMS= 0.19342167E 01     ADD TERM    5
CURR.ERMS= 0.19092956E 01     ADD TERM   21

T1= 0.16450000E 01 T2= 0.16450000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    5    6   10   13   21

COEFFICIENTS
-0.13785953E 00 -0.35647835E-02  0.10143093E 03  0.56466490E-02 -0.39270982E-01

 0.18961616E 01=ERMS            0.18961616E 01=RE.ERMS

SIGMAS
 0.51597249E-01  0.49029916E-03  0.56543897E 00  0.17108767E-02  0.20161101E-01

T'S
-0.26718388E 01 -0.72706294E 01  0.17938440E 03  0.33004417E 01 -0.19478590E 01

 0.44385730E 00=RHO             0.19700930E 00=RHO**2
```

```
MULTIPLE REGRESSION                                         MULTIPLE REGRESSION
SUBPROG. NO.=        2                                      SUBPROG. NO.=        2
NOS. PER EQ.=       28                                      NOS. PER EQ.=       28
NO. OF TERMS=       23                                      NO. OF TERMS=       23
      RUN   3 - 2                                                 RUN   3 - 2
NO. OF INPUT LINES=          44                             NO. OF INPUT LINES=          44
CURR.ERMS= 0.99348892E 02     ADD TERM   12                 MEAN= 0.99348409E 02
CURR.ERMS= 0.31321249E 00     ADD TERM   14                 S. DEV.= 0.31321249E 00
CURR.ERMS= 0.29421560E 00     ADD TERM   22
CURR.ERMS= 0.28317510E 00     ADD TERM   15
CURR.ERMS= 0.27840552E 00     ADD TERM    3
CURR.ERMS= 0.26724191E 00  REMOVE TERM   14
CURR.ERMS= 0.26988418E 00     ADD TERM   16
CURR.ERMS= 0.26416838E 00     ADD TERM    4
CURR.ERMS= 0.25927042E 00     ADD TERM    2

T1= 0.16710000E 01 T2= 0.16710000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    2    3    4   12   15   16   22

COEFFICIENTS
-0.20414171E-01 -0.38811321E-03  0.22881288E 00  0.99134819E 02  0.15621499E-02
 0.86087841E-03  0.10864589E 00

 0.25417952E 00=ERMS            0.25417952E 00=RE.ERMS

SIGMAS
 0.12815478E-01  0.12547652E-03  0.14237320E 00  0.10922467E 01  0.55370647E-03
 0.43182497E-03  0.43301289E-01

T'S
-0.15929309E 01 -0.30931143E 01  0.16071344E 01  0.90762298E 02  0.28212600E 01
 0.19935818E 01  0.25090682E 01

 0.58431877E 00=RHO             0.34142843E 00=RHO**2
```

```
MULTIPLE REGRESSION                                         MULTIPLE REGRESSION
SUBPROG. NO.=        3                                      SUBPROG. NO.=        3
NOS. PER EQ.=       28                                      NOS. PER EQ.=       28
NO. OF TERMS=       23                                      NO. OF TERMS=       23
      RUN    3 - 3                                                RUN    3 - 3
NO. OF INPUT LINES=        172                              NO. OF INPUT LINES=        172
CURR.ERMS= 0.95307324E 02      ADD TERM    10               MEAN= 0.99280698E 02
CURR.ERMS= 0.23062074E 01      ADD TERM     6               S. DEV.= 0.23062074E 01
CURR.ERMS= 0.21197690E 01      ADD TERM    13
CURR.ERMS= 0.20702133E 01      ADD TERM     5
CURR.ERMS= 0.20435113E 01      ADD TERM    23
CURR.ERMS= 0.20187618E 01      ADD TERM    22
CURR.ERMS= 0.20054654E 01      ADD TERM    20
CURR.ERMS= 0.19931222E 01   REMOVE TERM    23

T1= 0.16450000E 01 T2= 0.16450000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    5    6   10   13   20   22

COEFFICIENTS
-0.14456580E 00 -0.38607312E-02  0.10105256E 03  0.67040650E-02 -0.38031435E 00
 0.11573956E-02

 0.20015521E 01=ERMS           0.20015521E 01=RE.ERMS

SIGMAS
 0.59166837E-01  0.52918032E-03  0.58445967E 00  0.20506923E-02  0.17256099E 00
 0.42272383E-03

T'S
-0.24433586E 01 -0.72956818E 01  0.17289911E 03  0.32691716E 01 -0.22039416E 01
 0.27379473E 01

 0.49674299E 00=RHO            0.24675360E 00=RHO**2
```

```
MULTIPLE REGRESSION                                          MULTIPLE REGRESSION
SUBPROG. NO.=       4                                        SUBPROG. NO.=       4
NOS. PER EQ.=      28                                        NOS. PER EQ.=      28
NO. OF TERMS=      25                                        NO. OF TERMS=      25
      RUN   3 - 4                                                  RUN   3 - 4
NO. OF INPUT LINES=          35                              NO. OF INPUT LINES=          35
CURR.ERMS= 0.99399936E 02      ADD TERM   12                 MEAN= 0.99399429E 02
CURR.ERMS= 0.32235296E 00      ADD TERM   14                 S. DEV.= 0.32235296E 0
CURR.ERMS= 0.30800228E 00      ADD TERM   24
CURR.ERMS= 0.28972202E 00      ADD TERM   10
CURR.ERMS= 0.27784567E 00      ADD TERM    8
CURR.ERMS= 0.25074810E 00   REMOVE TERM   14
CURR.ERMS= 0.24668060E 00   REMOVE TERM   24
CURR.ERMS= 0.25123577E 00      ADD TERM   15

T1= 0.16710000E 01 T2= 0.16710000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    8   10   12   15

COEFFICIENTS
-0.11791389E-02  0.10097108E-02  0.99162732E 02  0.13056089E-02

 0.23542056E 00=ERMS            0.23542056E 00=RE.ERMS

SIGMAS
 0.23992662E-03  0.22391256E-03  0.95338147E-01  0.55957764E-03

T'S
-0.49145815E 01  0.45093978E 01  0.10401160E 04  0.23332042E 01

 0.68310604E 00=RHO             0.46663386E 00=RHO**2
```

```
JULY 11,74  BRLESC2 FORTRAN.                                                  CR 17..33
*      HE 415 LILA --LIWC  BLDG 328 X4542                                                 *

MULTIPLE REGRESSION                                        MULTIPLE REGRESSION
SUBPROG. NO.=        1                                     SUBPROG. NO.=        1
NOS. PER EQ.=       28                                     NOS. PER EQ.=       28
NO. OF TERMS=       21                                     NO. OF TERMS=       21
       RUN    4 - 1                                               RUN    4 - 1
NO. OF INPUT LINES=              86                        NO. OF INPUT LINES=           86
CURR.ERMS= 0.99248375E 02      ADD TERM     4              MEAN= 0.99247674E 02
CURR.ERMS= 0.37513503E 00      ADD TERM     8              S. DEV.= 0.37513503E 00
CURR.ERMS= 0.33747466E 00      ADD TERM    11
CURR.ERMS= 0.33000080E 00      ADD TERM    17

T1= 0.16580000E 01 T2= 0.16580000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
     4     8    11    17

COEFFICIENTS
 0.98968842E 02  0.82288196E-03  0.58846518E-01 -0.49081371E-02

 0.32609376E 00=ERMS              0.32609376E 00=RE.ERMS

SIGMAS
 0.13649682E 00  0.15711002E-03  0.24866625E-01  0.28333291E-02

T'S
 0.72506336E 03  0.52375659E 01  0.23671570E 01 -0.17322863E 01

 0.49433699E 00=RHO               0.24436906E 00=RHO**2
```

```
MULTIPLE REGRESSION
SUBPROG. NO.=       2
NOS. PER EQ.=      28
NO. OF TERMS=      23
      RUN   4 - 2
NO. OF INPUT LINES=          81
CURR.ERMS= 0.99235896E 02      ADD TERM     4
CURR.ERMS= 0.37784954E 00      ADD TERM    10
CURR.ERMS= 0.34145834E 00      ADD TERM    13

T1= 0.16580000E 01 T2= 0.16580000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    4    10    13

COEFFICIENTS
 0.98824512E 02  0.74261921E-03  0.51563016E-01

 0.33526058E 00=ERMS            0.33526058E 00=RE.ERMS

SIGMAS
 0.10628134E 00  0.15926906E-03  0.25951233E-01

T'S
 0.92983876E 03  0.46626708E 01  0.19869197E 01

 0.46121981E 00=RHO             0.21272371E 00=RHO**2
```

```
MULTIPLE REGRESSION
SUBPROG. NO.=       2
NOS. PER EQ.=      28
NO. OF TERMS=      23
      RUN   4 - 2
NO. OF INPUT LINES=          81
MEAN= 0.99235185E 02
S. DEV.= 0.37784954E 00
```

```
MULTIPLE REGRESSION
SUBPROG. NO.=        3
NOS. PER EQ.=       28
NO. OF TERMS=       23
      RUN    4 - 3
NO. OF INPUT LINES=          83
CURR.ERMS= 0.99234185E 02      ADD TERM     4
CURR.ERMS= 0.37249139E 00      ADD TERM     8
CURR.ERMS= 0.33440374E 00      ADD TERM    11
CURR.ERMS= 0.32874533E 00      ADD TERM    17

T1= 0.16580000E 01 T2= 0.16580000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    4     8    11    17

COEFFICIENTS
 0.99015757E 02  0.82202996E-03  0.53398246E-01 -0.60098708E-02

 0.32204295E 00=ERMS            0.32204295E 00=RE.ERMS

SIGMAS
 0.13684025E 00  0.15553311E-03  0.24802894E-01  0.28766956E-02

T'S
 0.72358652E 03  0.52852410E 01  0.21529038E 01 -0.20891577E 01

 0.50252132E 00=RHO             0.25252767E 00=RHO**2
```

```
MULTIPLE REGRESSION
SUBPROG. NO.=        3
NOS. PER EQ.=       28
NO. OF TERMS=       23
      RUN    4 - 3
NO. OF INPUT LINES=          83
MEAN= 0.99233494E 02
S. DEV.= 0.37249139E 00
```

```
MULTIPLE REGRESSION                                          MULTIPLE REGRESSION
SUBPROG. NO.=       4                                        SUBPROG. NO.=       4
NOS. PER EQ.=      28                                        NOS. PER EQ.=      28
NO. OF TERMS=      25                                        NO. OF TERMS=      25
      RUN   4 - 4                                                  RUN   4 - 4
NO. OF INPUT LINES=          78                              NO. OF INPUT LINES=          78
CURR.ERMS= 0.99220313E 02      ADD TERM    4                 MEAN= 0.99219615E 02
CURR.ERMS= 0.37460435E 00      ADD TERM   10                 S. DEV.= 0.37460435E 00
CURR.ERMS= 0.33788319E 00      ADD TERM   13
CURR.ERMS= 0.33368631E 00      ADD TERM   19

T1= 0.16580000E 01 T2= 0.16530000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    4   10   13   19

COEFFICIENTS
 0.99006615E 02  0.79673007E-03  0.48775286E-01 -0.53741542E-02

 0.32911688E 00=ERMS             0.32911698E 00=RF.ERMS

SIGMAS
 0.14196308E 00  0.16170425E-03  0.25900981E-01  0.30537720E-02

T'S
 0.69741099E 03  0.49270820E 01  0.18831444E 01 -0.17598413E 01

 0.47760999E 00=RHO              0.22811130E 00=RHO**2
```

```
MULTIPLE REGRESSION                                           MULTIPLE REGRESSION
SUBPROG. NO.=        1                                        SUBPROG. NO.=        1
NOS. PER EQ.=       28                                        NOS. PER EQ.=       28
NO. OF TERMS=       21                                        NO. OF TERMS=       21
      RUN    5 - 1                                                  RUN    5 - 1
NO. OF INPUT LINES=        294                                NO. OF INPUT LINES=        294
CURR.ERMS= 0.99336183E 02      ADD TERM    10                 MEAN= 0.99320340E 02
CURR.ERMS= 0.17770632E 01      ADD TERM     6                 S. DEV.= 0.17770632E 01
CURR.ERMS= 0.16636100E 01      ADD TERM    21
CURR.ERMS= 0.16715110E 01      ADD TERM    13
CURR.ERMS= 0.16562863E 01      ADD TERM     5

T1= 0.16450000E 01 T2= 0.16450000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    5     6    10    13    21

COEFFICIENTS
-0.12915046E 00 -0.27394258E-02  0.10126729E 03  0.40741617E-02 -0.39723005E-01

 0.16307889E 01=ERMS             0.16307889E 01=RE.ERMS

SIGMAS
 0.39186759E-01  0.36450714E-03  0.43348354E 00  0.11734299E-02  0.13613508E-01

T'S
-0.32957679E 01 -0.75154242E 01  0.23361276E 03  0.34720112E 01 -0.29179110E 01

 0.39730267E 00=RHO              0.15784941E 00=RHO**2
```

```
MULTIPLE REGRESSION
SUBPROG. NO.=        2
NOS. PER EQ.=       28
NO. OF TERMS=       23
      RUN   5 - 2
NO. OF INPUT LINES=          130
CURR.ERMS= 0.99374967E 02      ADD TERM    12
CURR.ERMS= 0.34152872E 00      ADD TERM    23
CURR.ERMS= 0.31427057E 00      ADD TERM    15
CURR.ERMS= 0.29331337E 00      ADD TERM     8
CURR.ERMS= 0.28491613E 00      ADD TERM    10
CURR.ERMS= 0.27292481E 00      ADD TERM     9
CURR.ERMS= 0.26451293E 00      ADD TERM    21
CURR.ERMS= 0.25958252E 00      ADD TERM     1
CURR.ERMS= 0.25348471E 00      ADD TERM    14
CURR.ERMS= 0.25063336E 00      ADD TERM     4
CURR.ERMS= 0.24870381E 00   REMOVE TERM    21

T1= 0.16450000E 01 T2= 0.16450000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    1     4     6     9    10    12    14    15    23

COEFFICIENTS
 0.12944402E-02  0.83549989E-01 -0.55413720E-03 -0.49529507E-03  0.42581050E-03
 0.98678603E 02  0.54609786E-03  0.13211310E-02 -0.12911523E-01

 0.24882036E 00=ERMS             0.24882036E 00=RE.ERMS

SIGMAS
 0.36331407E-03  0.21321637E-01  0.11656448E-03  0.18884131E-03  0.10205206E-03
 0.19509863E 00  0.25894634E-03  0.39880209E-03  0.41675268E-02

T'S
 0.35628684E 01  0.39185541E 01 -0.47539114E 01 -0.26228110E 01  0.41725717E 01
 0.50578829E 03  0.21106465E 01  0.33124976E 01 -0.30981259E 01

 0.68499384E 00=RHO              0.46921656E 00=RHO**2
```

```
MULTIPLE REGRESSION
SUBPROG. NO.=        2
NOS. PER EQ.=       28
NO. OF TERMS=       23
      RUN   5 - 2
NO. OF INPUT LINES=          130
MEAN= 0.99374385E 02
S. DEV.= 0.34152872E 00
```

```
MULTIPLE REGRESSION                                                MULTIPLE REGRESSION
SUBPROG. NO.=        3                                             SUBPROG. NO.=        3
NOS. PER EQ.=       28                                             NOS. PER EQ.=       28
NO. OF TERMS=       23                                             NO. OF TERMS=       23
      RUN    5 - 3                                                       RUN    5 - 3
NO. OF INPUT LINES=         260                                    NO. OF INPUT LINES=         260
CURR.ERMS= 0.99338107E 02      ADD TERM    10                      MEAN= 0.99320269E 02
CURR.ERMS= 0.18861045E 01      ADD TERM     6                      S. DEV.= 0.18861045E 01
CURR.ERMS= 0.17739372E 01      ADD TERM    23
CURR.ERMS= 0.17556162E 01      ADD TERM    13
CURR.ERMS= 0.17403483E 01      ADD TERM     5
CURR.ERMS= 0.17096857E 01      ADD TERM    22

T1= 0.16450000E 01 T2= 0.16450000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    5    6   10   13   22   23

COEFFICIENTS
-0.14269478E 00 -0.31779654E-02  0.10133971E 03  0.44460261E-02  0.61832007E-03
-0.48526630E-01

 0.16976926E 01=ERMS              0.16976926E 01=RE.ERMS

SIGMAS
 0.43390053E-01  0.40430134E-03  0.48761229E 00  0.13130399E-02  0.28780730E-03
 0.17528535E-01

T'S
-0.32886519E 01 -0.78603380E 01  0.20782846E 03  0.33860557E 01  0.21483822E 01
-0.27684362E 01

 0.43567247E 00=RHO               0.18981050E 00=RHO**2
```

```
MULTIPLE REGRESSION
SUBPROG. NO.=        4
NOS. PER EQ.=       28
NO. OF TERMS=       25
      RUN   5 - 4
NO. OF INPUT LINES=          120
CURR.ERMS= 0.99393764E 02       ADD TERM   12
CURR.ERMS= 0.34612375E 00       ADD TERM   25
CURR.ERMS= 0.31763797E 00       ADD TERM   15
CURR.ERMS= 0.29355672E 00       ADD TERM    8
CURR.ERMS= 0.28098852E 00       ADD TERM   10
CURR.ERMS= 0.27101255E 00       ADD TERM    9
CURR.ERMS= 0.26030982E 00       ADD TERM    4
CURR.ERMS= 0.25058013E 00       ADD TERM    1
CURR.ERMS= 0.23732991E 00       ADD TERM   14
CURR.ERMS= 0.23277314E 00       ADD TERM   17
CURR.ERMS= 0.22886732E 00       ADD TERM    6

MULTIPLE REGRESSION
SUBPROG. NO.=        4
NOS. PER EQ.=       28
NO. OF TERMS=       25
      RUN   5 - 4
NO. OF INPUT LINES=          120
MEAN= 0.99393167E 02
S. DEV.= 0.34612375E 00

T1= 0.16580000E 01 T2= 0.16580000E 01 T4= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    1    4    6    8    9   10   12   14   15   17   25

COEFFICIENTS
 0.11251804E-02  0.94314459E-01 -0.17991228E-02 -0.63849231E-03 -0.58143903E-03
 0.50341208E-03  0.96870382E 02  0.97483315E-03  0.23834945E-02 -0.17838222E-02
-0.18098194E-01

 0.22674080E 00=ERMS             0.22674080E 00=RE.ERMS

SIGMAS
 0.41343038E-03  0.24072047E-01  0.10263157E-02  0.11243770E-03  0.13439261E-03
 0.10594438E-03  0.23784399E 00  0.31609120E-03  0.50758330E-03  0.79123217E-03
 0.50291216E-02

T'S
 0.27215717E 01  0.39180075E 01 -0.17529916E 01 -0.56786318E 01 -0.31548062E 01
 0.47516640E 01  0.41569427E 03  0.30840250E 01  0.46957702E 01 -0.22544865E 01
-0.35986789E 01

 0.75555440E 00=RHO              0.57086245E 00=RHO**2
```

```
MULTIPLE REGRESSION                                                   MULTIPLE REGRESSION
SUBPROG. NO.=         1                                               SUBPROG. NO.=         1
NOS. PER EQ.=        28                                               NOS. PER EQ.=        28
NO. OF TERMS=        21                                               NO. OF TERMS=        21
      RUN    6 - 1                                                          RUN    6 - 1
NO. OF INPUT LINES=           89                                      NO. OF INPUT LINES=           89
CURR.ERMS= 0.99395350E 02       ADD TERM     4                        MEAN= 0.99394719E 02
CURR.ERMS= 0.35602952E 00       ADD TERM    13                        S. DEV.= 0.35602952E 00
CURR.ERMS= 0.30344703E 00       ADD TERM     8
CURR.ERMS= 0.25278508E 00       ADD TERM     5
CURR.ERMS= 0.23093937E 00       ADD TERM     7
CURR.ERMS= 0.22004640E 00       ADD TERM     6
CURR.ERMS= 0.20803496E 00       ADD TERM    17
CURR.ERMS= 0.18519371E 00    REMOVE TERM     7
CURR.ERMS= 0.18518827E 00       ADD TERM    21
CURR.ERMS= 0.18021707E 00       ADD TERM     3
CURR.ERMS= 0.17816128E 00       ADD TERM    14
CURR.ERMS= 0.17416294E 00       ADD TERM    18

T1= 0.16580000E 01 T2= 0.16560000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    3     4     5     6     8    13    14    17    18    21

COEFFICIENTS
-0.88070086E-03  0.10013072E 03 -0.30707264E 00 -0.16831023E-02  0.55234446E-03
 0.42151563E-02  0.55949348E-02  0.32632569E-03  0.51426081E-02 -0.10438427E-01

 0.17100219E 00=ERMS              0.17100219E 00=RF.ERMS

SIGMAS
 0.29083337E-03  0.34523471E 00  0.33457292E-01  0.24661211E-03  0.87053831E-04
 0.61233625E-03  0.22819446E-02  0.71733034E-04  0.25752272E-02  0.38545783E-02

T'S
-0.30262250E 01  0.29003664E 03 -0.91780480E 01 -0.68248971E 01  0.63448611E 01
 0.68837281E 01  0.24518276E 01  0.45491690E 01  0.19961781E 01 -0.27010519E 01

 0.87710242E 00=RHO               0.76930866E 00=RHO**2
```

```
MULTIPLE REGRESSION
SUBPROG. NO.=        2
NOS. PER EQ.=       28
NO. OF TERMS=       23
      RUN    6 - 2
NO. OF INPUT LINES=          86
CURR.ERMS= 0.99388305E 02       ADD TERM     4
CURR.ERMS= 0.35618130E 00       ADD TERM    15
CURR.ERMS= 0.30286096E 00       ADD TERM    10
CURR.ERMS= 0.25703013E 00       ADD TERM     5
CURR.ERMS= 0.23462422E 00       ADD TERM     9
CURR.ERMS= 0.22400282E 00       ADD TERM     8
CURR.ERMS= 0.21166225E 00       ADD TERM    19
CURR.ERMS= 0.18791566E 00    REMOVE TERM     9
CURR.ERMS= 0.18780054E 00       ADD TERM    23
CURR.ERMS= 0.18279980E 00       ADD TERM    20
CURR.ERMS= 0.18041640E 00       ADD TERM     3
CURR.ERMS= 0.17826060E 00       ADD TERM    16

T1= 0.16580000E 01 T2= 0.16580000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    3     4     5     8    10    15    16    19    20    23

COEFFICIENTS
-0.86235928E-03   0.10014229E 03 -0.30681227E 00 -0.16852122E-02   0.54547242E-03
 0.41875320E-02   0.55541865E-02   0.32652176E-03   0.57461945E-02 -0.10922072E-01

 0.17327599E 00=ERMS            0.17327599E 00=RE.ERMS

SIGMAS
 0.29869662E-03   0.35719678E 00   0.34091987E-01   0.25011259E-03   0.96078716E-04
 0.62174457E-03   0.23696444E-02   0.75656846E-04   0.26887287E-02   0.40491167E-02

T'S
-0.28870742E 01   0.28035609E 03 -0.89996420E 01 -0.67378117E 01   0.56878302E 01
 0.67351323E 01   0.23438903E 01   0.43156258E 01   0.21371418E 01 -0.27051378E 01

 0.87369028E 00=RHO             0.76333471E 00=RHO**2
```

MULTIPLE REGRESSION
SUBPROG. NO.= 2
NOS. PER EQ.= 28
NO. OF TERMS= 23
RUN 6 - 2
NO. OF INPUT LINES= 86
MEAN= 0.99387674E 02
S. DEV.= 0.35618130E 00

```
MULTIPLE REGRESSION                                                  MULTIPLE REGRESSION
SUBPROG. NO.=        3                                               SUBPROG. NO.=        3
NOS. PER EQ.=       28                                               NOS. PER EQ.=       28
NO. OF TERMS=       23                                               NO. OF TERMS=       23
      RUN    6 - 3                                                         RUN    6 - 3
NO. OF INPUT LINES=           88                                     NO. OF INPUT LINES=          88
CURR.ERMS= 0.99399248E 02       ADD TERM     4                       MEAN= 0.99397614E 02
CURR.ERMS= 0.35701507E 00       ADD TERM    13                       S. DEV.= 0.35701507E 00
CURR.ERMS= 0.30314993E 00       ADD TERM     8
CURR.ERMS= 0.25375890E 00       ADD TERM     5
CURR.ERMS= 0.23203371E 00       ADD TERM     7
CURR.ERMS= 0.22011896E 00       ADD TERM     6
CURR.ERMS= 0.20817191E 00       ADD TERM    17
CURR.ERMS= 0.15393979E 00       ADD TERM    23
CURR.ERMS= 0.17931681E 00    REMOVE TERM     7
CURR.ERMS= 0.18019497E 00       ADD TERM    22
CURR.ERMS= 0.17751418E 00       ADD TERM     3
CURR.ERMS= 0.17468461E 00       ADD TERM    14
CURR.ERMS= 0.17063756E 00       ADD TERM    18

T1= 0.16580000E 01 T2= 0.16580000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    3     4     5     6     8    13    14    17    18    22    23

COEFFICIENTS
-0.88470345E-03  0.10032549E 03 -0.33008844E 00 -0.17741761E-02  0.53324368E-03
 0.42728714E-02  0.54209355E-02  0.36272206E-03  0.54017123E-02 -0.12884836E-03
-0.10793825E-01

 0.16706605E 00=ERMS              0.16706605E 00=RF.ERMS

SIGMAS
 0.28474135E-03  0.34899613E 00  0.34069030E-01  0.24390255E-03  0.91843098E-04
 0.60157640E-03  0.22425783E-02  0.72210640E-04  0.25291816E-02  0.61742003E-04
 0.37861044E-02

T'S
-0.31070424E 01  0.28746712E 03 -0.96888125E 01 -0.72741185E 01  0.68948424E 01
 0.71027908E 01  0.24172761E 01  0.50231111E 01  0.21357550E 01 -0.20868835E 01
-0.28509053E 01

 0.88375358E 00=RHO               0.78102057E 00=RHO**2
```

```
MULTIPLE REGRESSION                                                    MULTIPLE REGRESSION
SUBPROG. NO.=        4                                                 SUBPROG. NO.=        4
NOS. PER EQ.=       28                                                 NOS. PER EQ.=       28
NO. OF TERMS=       25                                                 NO. OF TERMS=       25
       RUN    6 - 4                                                           RUN    6 - 4
NO. OF INPUT LINES=           85                                       NO. OF INPUT LINES=           85
CURR.ERMS= 0.99391223E 02      ADD TERM    4                           MEAN= 0.99390588E 02
CURR.ERMS= 0.35722258E 00      ADD TERM   15                           S. DEV.= 0.35726258E 00
CURR.ERMS= 0.30261651E 00      ADD TERM   10
CURR.ERMS= 0.25806729E 00      ADD TERM    5
CURR.ERMS= 0.23578445E 00      ADD TERM    9
CURR.ERMS= 0.22411278E 00      ADD TERM    8
CURR.ERMS= 0.21185371E 00      ADD TERM   19
CURR.ERMS= 0.18656821E 00   REMOVE TERM    9
CURR.ERMS= 0.18817763E 00      ADD TERM   25
CURR.ERMS= 0.18275305E 00      ADD TERM   24
CURR.ERMS= 0.17953731E 00      ADD TERM   20
CURR.ERMS= 0.17620715E 00      ADD TERM    3
CURR.ERMS= 0.17314049E 00      ADD TERM   16
CURR.ERMS= 0.16837166E 00      ADD TERM    7

T1= 0.16680000E 01 T2= 0.16580000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    3     4     5     7     8    10    15    16    19    20    24    25

COEFFICIENTS
-0.89332089E-13  0.10026874E 03 -0.33492690E 00  0.16300524E-02 -0.17989190E-02
 0.67641969E-03  0.41240990E-02  0.55485238E-02  0.36839183E-03  0.73796643E-02
-0.17224541E-03 -0.10415447E-01

 0.16578914E 00=ERMS               0.16578914E 00=RE.ERMS

SIGMAS
 0.28710459E-03  0.35732253E 00  0.34075370E-01  0.89415382E-03  0.24255567E-03
 0.10085554E-03  0.60138155E-03  0.22873444E-02  0.74739453E-04  0.26511828E-02
 0.64317311E-04  0.39066098E-02

T'S
-0.31114824E 01  0.28061130E 03 -0.98290025E 01  0.18230112E 01 -0.74162143E 01
 0.67068172E 01  0.68520199E 01  0.24257492E 01  0.49290143E 01  0.27730768E 01
-0.26780566E 01 -0.26660679E 01

 0.88580690E 00=RHO                0.78465336E 00=RHO**2
```

```
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MULTIPLE REGRESSION                                                MULTIPLE REGRESSION
SUBPROG. NO.=        1                                             SUBPROG. NO.=        1
NOS. PER EQ.=       28                                             NOS. PER EQ.=       28
NO. OF TERMS=       21                                             NO. OF TERMS=       21
      RUN    7 - 1                                                       RUN    7 - 1
NO. OF INPUT LINES=         245                                    NO. OF INPUT LINES=        245
CURR.ERMS= 0.99340718E 02      ADD TERM    10                      MEAN= 0.9934.163E 02
CURR.ERMS= 0.33278010E 00      ADD TERM    21                      S. DEV.= [illegible].33278010E [illegible]
CURR.ERMS= 0.31982152E 00      ADD TERM     6
CURR.ERMS= 0.30802403E 00      ADD TERM     8
CURR.ERMS= 0.28135276E 00      ADD TERM    15
CURR.ERMS= 0.27702682E 00      ADD TERM     2
CURR.ERMS= 0.27571404E 00      ADD TERM    19
CURR.ERMS= 0.27418537E 00      ADD TERM     5

T1= 0.16450000E 01 T2= 0.16450000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    2    5    6    8   10   15   19   21

COEFFICIENTS
 0.11286331E-01 -0.12656225E-01 -0.77561637E-03  0.55784780E-03  0.49349605E 02
-0.53643534E-03  0.36540815E-02 -0.75300996E-02

 0.27285993E 00=ERMS           0.27285993E 00=RE.ERMS

SIGMAS
 0.55555457E-02  0.69482821E-02  0.89160168E-04  0.86968202E-04  0.18013458E 00
 0.19413824E-03  0.18840411E-02  0.24103614E-02

T'S
 0.20315431E 01 -0.18214899E 01 -0.86591354E 01  0.64143881E 01  0.27395963E 03
-0.27631616E 01  0.19394914E 01 -0.31240542E 01

 0.57244855E 00=RHO            0.32769734E 00=RHO**2
```

```
MULTIPLE REGRESSION                                         MULTIPLE REGRESSION
SUBPROG. NO.=       2                                       SUBPROG. NO.=       2
NOS. PER EQ.=      28                                       NOS. PER EQ.=      28
NO. OF TERMS=      23                                       NO. OF TERMS=      23
      RUN   7 - 2                                                 RUN   7 - 2
NO. OF INPUT LINES=          48                             NO. OF INPUT LINES=          48
CURR.ERMS= 0.99358584E 02     ADD TERM   12                 MEAN= 0.99358125E 02
CURR.ERMS= 0.30509612E 00     ADD TERM    8                 S. DEV.= 0.30509612E 00
CURR.ERMS= 0.28166135E 00     ADD TERM   10
CURR.ERMS= 0.21009319E 00     ADD TERM    5
CURR.ERMS= 0.19902029E 00     ADD TERM   23
CURR.ERMS= 0.19384798E 00     ADD TERM    2
CURR.ERMS= 0.18613500E 00     ADD TERM    1
CURR.ERMS= 0.17881147E 00     ADD TERM    4

T1= 0.16710000E 01 T2= 0.16710000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    1     2     4     5     8    10    12    23

COEFFICIENTS
 0.13793775E-02  0.22944668E-01  0.15833894E 00 -0.32490789E-01 -0.14891799E-02
 0.65565697E-03  0.48682462E 02 -0.19980479E-01

 0.17348926E 00=ERMS            0.17348926E 00=RE.ERMS

SIGMAS
 0.57877083E-03  0.10092864E-01  0.83988630E-01  0.14198397E-01  0.22979772E-03
 0.26367530E-03  0.40126419E 00  0.54867881E-02

T'S
 0.23832878E 01  0.22733555E 01  0.18852425E 01 -0.22883421E 01 -0.64803947E 01
 0.24866075E 01  0.12132272E 03 -0.36415619E 01

 0.82258787E 00=RHO             0.67665080E 00=RHO**2
```

```
MULTIPLE REGRESSION
SUBPROG. NO.=        3
NOS. PER EQ.=       28
NO. OF TERMS=       23
      RUN   7 - 3
NO. OF INPUT LINES=          201
CURR.ERMS= 0.99364881E 02      ADD TERM   10
CURR.ERMS= 0.33230960E 00      ADD TERM    8
CURR.ERMS= 0.31827618E 00      ADD TERM    6
CURR.ERMS= 0.27974247E 00      ADD TERM   15
CURR.ERMS= 0.27430844E 00      ADD TERM   23
CURR.ERMS= 0.27295000E 00      ADD TERM    2

MULTIPLE REGRESSION
SUBPROG. NO.=        3
NOS. PER EQ.=       28
NO. OF TERMS=       23
      RUN   7 - 3
NO. OF INPUT LINES=          201
MEAN= 0.99364328E 02
S. DEV.= 0.33230960E 00

T1= 0.16450000E 01 T2= 0.16450000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    2    6    8   10   15   23

COEFFICIENTS
 0.12209448E-01 -0.73359834E-03  0.61144830E-03  0.49318379E 02 -0.65099147E-03
-0.61516244E-02

 0.27108376E 00=ERMS             0.27108376E 00=RE.ERMS

SIGMAS
 0.63405626E-02  0.90013367E-04  0.92249362E-04  0.19772678E 00  0.21198930E-03
 0.29138229E-02

T'S
 0.19256095E 01 -0.81498822E 01  0.66282117E 01  0.24942690E 03 -0.30708694E 01
-0.21111868E 01

 0.57839532E 00=RHO              0.33454114E 00=RHO**2
```

```
MULTIPLE REGRESSION                                       MULTIPLE REGRESSION
SUBPROG. NO.=        4                                    SUBPROG. NO.=        4
NOS. PER EQ.=       28                                    NOS. PER EQ.=       28
NO. OF TERMS=       25                                    NO. OF TERMS=       25
      RUN    7 - 4                                              RUN    7 - 4
NO. OF INPUT LINES=          35                           NO. OF INPUT LINES=          35
CURR.ERMS= 0.99414769E 02     ADD TERM    12              MEAN= 0.99414286E 02
CURR.ERMS= 0.31467337E 00     ADD TERM    10              S. DEV.= 0.31467337E 00
CURR.ERMS= 0.28458843E 00     ADD TERM     8
CURR.ERMS= 0.21482724E 00     ADD TERM     2

T1= 0.16710000E 01 T2= 0.16710000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    2    8   10   12

COEFFICIENTS
 0.29998673E-01 -0.11102317E-02  0.10863025E-02  0.48664175E 02

 0.20348912E 00=ERMS             0.20348912E 00=RE.ERMS

SIGMAS
 0.13888674E-01  0.22494470E-03  0.19458120E-03  0.43835936E 00

T'S
 0.21599378E 01 -0.49355763E 01  0.55827722E 01  0.11101434E 03

 0.76277179E 00=RHO              0.58182080E 00=RHO**2
```

```
MULTIPLE REGRESSION                                             MULTIPLE REGRESSION
SUBPROG. NO.=       1                                           SUBPROG. NO.=       1
NOS. PER EC.=      28                                           NOS. PER EC.=      28
NO. OF TERMS=      21                                           NO. OF TERMS=      21
      RUN   8 - 1                                                     RUN   8 - 1
NO. OF INPUT LINES=        206                                  NO. OF INPUT LINES=        206
CURR.ERMS= 0.99191749E 02     ADD TERM   11                     MEAN= 0.99159126E 02
CURR.ERMS= 0.25499747E 01     ADD TERM    6                     S. DEV.= 0.25499747E 01
CURR.ERMS= 0.24576222E 01     ADD TERM    2
CURR.ERMS= 0.24271113E 01     ADD TERM   18
CURR.ERMS= 0.24095960E 01     ADD TERM    8
CURR.ERMS= 0.23975044E 01     ADD TERM   21
CURR.ERMS= 0.23734864E 01     ADD TERM    1
CURR.ERMS= 0.23269736E 01     ADD TERM   20
CURR.ERMS= 0.23126765E 01     ADD TERM    5

T1= 0.16450000E 01 T2= 0.16450000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    1    2    5    6    8   11   18   20   21

COEFFICIENTS
 0.65699940E-02  0.12204078E 00 -0.10963501E 00 -0.21792330E-02 -0.31432566E-02
 0.31668658E 02 -0.79116865E-01 -0.32213705E 00 -0.91933275E-01

 0.23011178E 01=ERMS            0.23011178E 01=RE.ERMS

SIGMAS
 0.20292976E-02  0.49481820E-01  0.63359765E-01  0.76218700E-03  0.80878251E-03
 0.10571802E 01  0.40491466E-01  0.17107682E 00  0.27710710E-01

T'S
 0.32375705E 01  0.24663761E 01 -0.17303569E 01 -0.28591841E 01 -0.38864052E 01
 0.29955780E 02 -0.19539146E 01 -0.18829965E 01 -0.33176081E 01

 0.43088237E 00=RHO             0.18565962E 00=RHO**2
```

```
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MULTIPLE REGRESSION
SUBPROG. NO.=       2
NOS. PER EQ.=      28
NO. OF TERMS=      23
      RUN   8 - 2
NO. OF INPUT LINES=          40
CURR.ERMS= 0.992424??  02     ADD TERM    13
CURR.ERMS= 0.31882959E 00     ADD TERM     7
CURR.ERMS= 0.30073319E 00     ADD TERM    21
CURR.ERMS= 0.27195920E 00     ADD TERM    15

MULTIPLE REGRESSION
SUBPROG. NO.=       2
NOS. PER EQ.=      28
NO. OF TERMS=      23
      RUN   ? - 2
NO. OF INPUT LINES=          40
MEAN= 0.99242??E 02
S. DEV.= ?.319?2959E

T1= 0.16710000E 01 T2= 0.16710000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    7   13   15   21

COEFFICIENTS
 0.75139160E-02  0.33186998E 02  0.91804058E-03 -0.19627662E-01

 0.26644583E 00=ERMS            0.26644583E 00=RE.ERMS

SIGMAS
 0.20136482E-02  0.64922330E-01  0.57522970E-03  0.59455219E-02

T'S
 0.37314939E 01  0.51118003E 03  0.15959548E 01 -0.33012513E 01

 0.54918652E 00=RHC             0.3?16?583E 00=RHC**2
```

```
MULTIPLE REGRESSION                                                    MULTIPLE REGRESSION
SUBPROG. NO.=        3                                                 SUBPROG. NO.=        3
NOS. PER EQ.=       28                                                 NOS. PER EQ.=       28
NO. OF TERMS=       23                                                 NO. OF TERMS=       23
      RUN    8 - 3                                                           RUN    8 - 3
NO. OF INPUT LINES=          188                                       NO. OF INPUT LINES=          188
CURR.ERMS= 0.99192838E 02      ADD TERM    11                          MEAN= 0.99157128E 02
CURR.ERMS= 0.26685224E 01      ADD TERM    22                          S. DEV.= 0.26635224E 01
CURR.ERMS= 0.25194260E 01      ADD TERM     6
CURR.ERMS= 0.24679616E 01      ADD TERM     2
CURR.ERMS= 0.24234016E 01      ADD TERM    20
CURR.ERMS= 0.24005674E 01      ADD TERM     1
CURR.ERMS= 0.23708028E 01      ADD TERM    23
CURR.ERMS= 0.23352338E 01      ADD TERM     8
CURR.ERMS= 0.23246725E 01      ADD TERM    13
CURR.ERMS= 0.23136819E 01      ADD TERM    18

T1= 0.16450000E 01 T2= 0.16450000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
     1     2     6     8    11    13    18    20    22    23

COEFFICIENTS
 0.71658812E-02  0.90567321E-01 -0.25257363E-02 -0.16179494E-02  0.31857875E 02
 0.36759980E-02 -0.67438461E-01 -0.36615643E 00 -0.26151534E-02 -0.82122703E-01

 0.23027884E 01=ERMS             0.23027884E 01=RE.ERMS

SIGMAS
 0.21196128E-02  0.53047720E-01  0.77291664E-03  0.90906950E-03  0.10993174E 01
 0.22361762E-02  0.41060401E-01  0.17998151E 00  0.62523593E-03  0.28451650E-01

T'S
 0.33807501E 01  0.17072802E 01 -0.32677991E 01 -0.17797863E 01  0.28979687E 02
 0.16438767E 01 -0.16424209E 01 -0.20455236E 01 -0.41826665E 01 -0.28863951E 01

 0.50529765E 00=RHO              0.25532572E 00=RHO**2
```

```
MULTIPLE REGRESSION
SUBPROG. NO.=       4
NOS. PER EQ.=      28
NO. OF TERMS=      25
       RUN   8 - 4
NO. OF INPUT LINES=          35
CURR.ERMS= 0.99258509E 02      ADD TERM    13
CURR.ERMS= 0.32253408E 00      ADD TERM     5
CURR.ERMS= 0.29906884E 00      ADD TERM    25
CURR.ERMS= 0.27943309E 00      ADD TERM     7
CURR.ERMS= 0.27116828E 00      ADD TERM    21
CURR.ERMS= 0.25298060E 00      ADD TERM    15
CURR.ERMS= 0.24497149E 00   REMOVE TERM    25

MULTIPLE REGRESSION
SUBPROG. NO.=       4
NOS. PER EQ.=      28
NO. OF TERMS=      25
       RUN   6 - 4
NO. OF INPUT LINES=          35
MEAN= 0.99258..0E 02
S. DEV.= 0.32253408E 0.

T1= 0.16970000E 01 T2= 0.16970000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    5    7   13   15   21

COEFFICIENTS
 0.32389042E-01  0.74697434E-02  0.33072906E 02  0.12742550E-02 -0.17968953E-01

 0.24767019E 00=ERMS            0.24767019E 00=RE.ERMS

SIGMAS
 0.18244938E-01  0.21981341E-02  0.85140512E-01  0.60307108E-03  0.59124386E-02

T'S
 0.17752345E 01  0.33982201E 01  0.38845087E 03  0.21129432E 01 -0.30391778E 01

 0.64058360E 00=RHO             0.41034735E 00=RHO**2
```

```
MULTIPLE REGRESSION                                          MULTIPLE REGRESSION
SUBPROG. NO.=        1                                       SUBPROG. NO.=        1
NOS. PER EQ.=       28                                       NOS. PER EQ.=       28
NO. OF TERMS=       21                                       NO. OF TERMS=       21
       RUN    9 - 1                                                 RUN    9 - 1
NO. OF INPUT LINES=           99                             NO. OF INPUT LINES=           99
CURR.ERMS= 0.99359085E 02      ADD TERM     4                MEAN= 0.99358354E 02
CURR.ERMS= 0.37529772E 00      ADD TERM     8                S. DEV.= 0.37529772E 00
CURR.ERMS= 0.32514555E 00      ADD TERM    13
CURR.ERMS= 0.31820251E 00      ADD TERM     6
CURR.ERMS= 0.30978479E 00      ADD TERM    16
CURR.ERMS= 0.31490855E 00      ADD TERM    14
CURR.ERMS= 0.28326820E 00      ADD TERM     5

T1= 0.16580000E 01 T2= 0.16580000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    4     5     6     8    13    14    16

COEFFICIENTS
 0.10025662E 03 -0.34594353E-01 -0.51937210E-03  0.76761652E-03  0.82658423E-03
 0.13593713E-01 -0.46490679E-01

 0.27922363E 00=ERMS             0.27922363E 00=RE.ERMS

SIGMAS
 0.25515583E 00  0.17951472E-01  0.15546598E-03  0.10854280E-03  0.42791486E-03
 0.30990157E-02  0.10161380E-01

T'S
 0.39292310E 03 -0.19271039E 01 -0.26038129E 01  0.70720169E 01  0.19316558E 01
 0.43864614E 01 -0.45752329E 01

 0.66817330E 00=RHO              0.44645556E 00=RHO**2
```

```
MULTIPLE REGRESSION                                              MULTIPLE REGRESSION
SUBPROG. NO.=        2                                           SUBPROG. NO.=        2
NOS. PER EQ.=       28                                           NOS. PER EQ.=       28
NO. OF TERMS=       23                                           NO. OF TERMS=       23
      RUN    9 - 2                                                     RUN    9 - 2
NO. OF INPUT LINES=          91                                  NO. OF INPUT LINES=          91
CURR.ERMS= 0.99346214E 02      ADD TERM     4                    MEAN= 0.99345495E 02
CURR.ERMS= 0.38018201E 00      ADD TERM    10                    S. DEV.= 0.38018201E
CURR.ERMS= 0.33217071E 00      ADD TERM    15
CURR.ERMS= 0.32515468E 00      ADD TERM     8
CURR.ERMS= 0.31685918E 00      ADD TERM    18
CURR.ERMS= 0.31317493E 00      ADD TERM    16
CURR.ERMS= 0.29088524E 00      ADD TERM     5

T1= 0.16580000E 01 T2= 0.16580000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    4    5    8   10   15   16   18

COEFFICIENTS
 0.10023709E 03 -0.34964539E-01 -0.51644888E-03  0.76685186E-03  0.81492645E-03
 0.13657386E-01 -0.46323074E-01

 0.28689458E 00=ERMS            0.28689458E 00=RE.ERMS

SIGMAS
 0.26897871E 00  0.18982416E-01  0.20715507E-03  0.12097664E-03  0.45495171E-03
 0.32443571E-02  0.10618772E-01

T'S
 0.37265806E 03 -0.18387828E 01 -0.24930545E 01  0.63388426E 01  0.17912372E 01
 0.42095815E 01 -0.43623759E 01

 0.65615714E 00=RHO             0.43054219E 00=RHO**2
```

```
MULTIPLE REGRESSION                                           MULTIPLE REGRESSION
SUBPROG. NO.=        3                                        SUBPROG. NO.=        3
NOS. PER EQ.=       28                                        NOS. PER EQ.=       28
NO. OF TERMS=       23                                        NO. OF TERMS=       23
      RUN   9 - 3                                                   RUN   9 - 3
NO. OF INPUT LINES=          96                               NO. OF INPUT LINES=          96
CURR.ERMS= 0.99350289E 02     ADD TERM    4                   MEAN= 0.99349583E 02
CURR.ERMS= 0.37629752E 00     ADD TERM    8                   S. DEV.= 0.37629752E 0
CURR.ERMS= 0.32254844E 00     ADD TERM   13
CURR.ERMS= 0.31458199E 00     ADD TERM    6
CURR.ERMS= 0.30604972E 00     ADD TERM   16
CURR.ERMS= 0.30230239E 00     ADD TERM   14
CURR.ERMS= 0.28053687E 00     ADD TERM    5
CURR.ERMS= 0.27598272E 00     ADD TERM   21

T1= 0.16580000E 01 T2= 0.16580000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    4    5    6    8   13   14   16   21

COEFFICIENTS
 0.10025729E 03 -0.33386295E-01 -0.47909881E-03  0.73106444E-03  0.82748909E-03
 0.13657415E-01 -0.46402970E-01 -0.13062764E-02

 0.27261312E 00=ERMS           0.27261312E 00=RE.ERMS

SIGMAS
 0.25127023E 00  0.17826330E-01  0.19658547E-03  0.10727117E-03  0.42821438E-03
 0.30316775E-02  0.99435044E-02  0.72866812E-03

T'S
 0.39900185E 03 -0.18728642E 01 -0.24371019E 01  0.68151062E 01  0.19324178E 01
 0.45049035E 01 -0.46666616E 01 -0.17926905E 01

 0.68931511E 00=RHO            0.47515531E 00=RHO**2
```

```
MULTIPLE REGRESSION                                                   MULTIPLE REGRESSION
SUBPROG. NO.=        4                                                SUBPROG. NO.=        4
NOS. PER EQ.=       28                                                NOS. PER EQ.=       28
NO. OF TERMS=       25                                                NO. OF TERMS=       25
       RUN   9 - 4                                                           RUN   9 - 4
NO. OF INPUT LINES=          88                                       NO. OF INPUT LINES=          88
CURR.ERMS= 0.99336177E 02      ADD TERM     4                         MEAN= 0.99335435E 02
CURR.ERMS= 0.38106900E 00      ADD TERM    10                         S. DEV.= 0.38116900E 00
CURR.ERMS= 0.33032104E 00      ADD TERM    15
CURR.ERMS= 0.32108485E 00      ADD TERM     8
CURR.ERMS= 0.31273205E 00      ADD TERM     1
CURR.ERMS= 0.30981473E 00      ADD TERM    25
CURR.ERMS= 0.30615739E 00      ADD TERM    18
CURR.ERMS= 0.30249469E 00      ADD TERM    16
CURR.ERMS= 0.28566921E 00   REMOVE TERM    25
CURR.ERMS= 0.28600607E 00   REMOVE TERM     1
CURR.ERMS= 0.28789730E 00      ADD TERM     5
CURR.ERMS= 0.28334556E 00      ADD TERM    23

T1= 0.16580000E 01 T2= 0.16580000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    4     5     8    10    15    16    18    23

COEFFICIENTS
 0.10023617E 03 -0.34141161E-01 -0.47815251E-03  0.72659387E-03  0.82368434E-03
 0.13734288E-01 -0.46195429E-01 -0.12265217E-02

 0.28052116E 00=ERMS            0.28052116E 00=RE.ERMS

SIGMAS
 0.26580048E 00  0.18887790E-01  0.20447577E-03  0.11973256E-03  0.45701168E-03
 0.31806672E-02  0.10415365E-01  0.75497338E-03

T'S
 0.37711057E 03 -0.18075784E 01 -0.23384312E 01  0.60684735E 01  0.18023267E 01
 0.43180527E 01 -0.44353155E 01 -0.16245893E 01

 0.67682636E 00=RHO             0.45809393E 00=RHO**2
```

```
MULTIPLE REGRESSION                                          MULTIPLE REGRESSION
SUBPROG. NO.=        1                                       SUBPROG. NO.=        1
NOS. PER EQ.=       28                                       NOS. PER EQ.=       28
NO. OF TERMS=       21                                       NO. OF TERMS=       21
      RUN  10 - 1                                                  RUN  10 - 1
NO. OF INPUT LINES=          56                              NO. OF INPUT LINES=          56
CURR.ERMS= 0.99290696E 02      ADD TERM     4                MEAN= 0.99290000E 02
CURR.ERMS= 0.37570298E 00      ADD TERM     8                S. DEV.= 0.37570298E 00
CURR.ERMS= 0.33823478E 00      ADD TERM    17

T1= 0.16710000E 01 T2= 0.16710000E 01 T3= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    4    8   17

COEFFICIENTS
 0.99153379E 02  0.10778967E-02 -0.58046913E-02

 0.33239208E 00=ERMS              0.33239208E 00=RE.ERMS

SIGMAS
 0.17946378E 00  0.29950401E-03  0.33999039E-02

T'S
 0.55249800E 03  0.35989491E 01 -0.17073606E 01

 0.46612217E 00=RHO               0.21726988E 00=RHO**2
```

```
MULTIPLE REGRESSION
SUBPROG. NO.=        2
NOS. PER EQ.=       28
NO. OF TERMS=       23
      RUN  10 - 2
NO. OF INPUT LINES=           51
CURR.ERMS= 0.99275035E 02      ADD TERM     4
CURR.ERMS= 0.38210080E 00      ADD TERM    10

T1= 0.16710000E 01 T2= 0.16710000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    4    10

COEFFICIENTS
 0.98919686E 02  0.10813124E-02

 0.34871106E 00=ERMS            0.34871106E 00=RE.ERMS

SIGMAS
 0.11739805E 00  0.32553105E-03

T'S
 0.84260074E 03  0.33216675E 01

 0.40881926E 00=RHO             0.16713318E 00=RHO**2
```

```
MULTIPLE REGRESSION
SUBPROG. NO.=        2
NOS. PER EQ.=       28
NO. OF TERMS=       23
      RUN  10 - 2
NO. OF INPUT LINES=           51
MEAN= 0.99274314E 02
S. DEV.= 0.38210080E 00
```

```
MULTIPLE REGRESSION                                                    MULTIPLE REGRESSION
SUBPROG. NO.=          3                                               SUBPROG. NO.=         3
NOS. PER EQ.=         28                                               NOS. PER EQ.=        28
NO. OF TERMS=         23                                               NO. OF TERMS=        23
      RUN  10 - 3                                                            RUN  10 - 3
NO. OF INPUT LINES=              53                                    NO. OF INPUT LINES=           53
CURR.ERMS= 0.99270880E 02        ADD TERM     4                        MEAN= 0.99270189E 02
CURR.ERMS= 0.37389062E 00        ADD TERM     8                        S. DEV.= 0.37389062E 00
CURR.ERMS= 0.33790187E 00        ADD TERM    15

T1= 0.16710000E 01  T2= 0.16710000E 01  TA= 0.00000000E 00  TB= 0.00000000E 00

TERMS
    4     8    15

COEFFICIENTS
 0.99226987E 02   0.10115404E-02 -0.20207669E-01

 0.32618778E 00=ERMS              0.32618778E 00=RE.ERMS

SIGMAS
 0.18064369E 00   0.29599226E-03   0.92641467E-02

T'S
 0.54929672E 03   0.34174557E 01 -0.21812769E 01

 0.48876590E 00=RHO               0.23889210E 00=RHO**2
```

```
MULTIPLE REGRESSION                                    MULTIPLE REGRESSION
SUBPROG. NO.=        4                                 SUBPROG. NO.=        4
NOS. PER EQ.=       28                                 NOS. PER EQ.=       28
NO. OF TERMS=       25                                 NO. OF TERMS=       25
     RUN  10 - 4                                            RUN  10 - 4
NO. OF INPUT LINES=          48                        NO. OF INPUT LINES=          48
CURR.ERRS= 0.99252169E 02     ADD TERM    4            MEAN= 0.99251458E 02
CURR.ERRS= 0.37947320E 00     ADD TERM   10            S. DEV.= 0.37947326E 00
CURR.ERRS= 0.34348264E 00     ADD TERM   17

T1= 0.16710000E 01 T2= 0.16710000E 01 TA= 0.00000000E 00 TB= 0.00000000E 00

TERMS
    4   10   17

COEFFICIENTS
 0.99210964E 02  0.47040293E-03 -0.18844553E-01

 0.33943430E 00=ERMS                 0.33943430E 00=RE.ERMS

SIGMAS
 0.19292748E 00  0.32064867E-03  0.10092143E-01

T'S
 0.51423967E 03  0.30263744E 01 -0.18668535E 01

 0.44709185E 00=RHO                  0.19989112E 00=RHO**2
```

```
MULTIPLE REGRESSION                                          MULTIPLE REGRESSION
SUBPROG. NO.=        1                                      SUBPROG. NO.=        1
NOS. PER EQ.=       28                                      NOS. PER EQ.=       28
NO. OF TERMS=       21                                      NO. OF TERMS=       21
      RUN  11 - 1                                                 RUN  11 - 1
NO. OF INPUT LINES=          43                             NO. OF INPUT LINES=          43
CURR.ERRS= [illegible]    ADD TERM     4                   MEAN= 0.99447442E 02
CURR.ERRS= [illegible]    ADD TERM    13                   S. DEV.= 0.35978891E 00
CURR.ERRS= [illegible]    ADD TERM     6
CURR.ERRS= [illegible]    ADD TERM     5
CURR.ERRS= [illegible]    ADD TERM     3
CURR.ERRS= [illegible]    ADD TERM    12
CURR.ERRS= [illegible]    ADD TERM     6
CURR.ERRS= [illegible]    ADD TERM    14
CURR.ERRS= [illegible]    ADD TERM    21
CURR.ERRS= [illegible]    ADD TERM     7

T1= 0.1671[illegible] 01  T2= 0.16710[illegible] 01  T3= 0.00000000E 00  T4= 0.[illegible] 00

TERMS
     3     4     5     6     7     8    12    13    14    21

COEFFICIENTS
-0.92013[illegible]  0.[illegible]412261E 02 -0.337[illegible]645E 0[illegible] -0.29[illegible]7721E-02  0.7[illegible]
 0.5789[illegible]47E-0[illegible]  0.2[illegible]392[illegible]12E-02  0.34422630E-02  0.12557638E-01 -0.1[illegible]71794E-01

 0.14144042E [illegible]                 0.14144042E 00=SE.ERRS

SIGMAS
 0.4931[illegible]  0.[illegible]  0.459[illegible]486E-01  0.34275142E-03  0.[illegible]
 0.98001227E-0[illegible]  0.[illegible]71E-03  0.6865[illegible]311E-03  0.26947387E-02  0.[illegible]

T'S
-0.22821724E 01  0.[illegible]  -0.7314[illegible]025E 01  -0.60328622E 01  0.[illegible]
 0.58541283E 01  0.[illegible]  0.50135415E 01  0.46600579E 01  -0.23447[illegible]

 0.91948694E [illegible]                 0.84545623E 00=RHO**2
```

```
MULTIPLE REGRESSION
SUBPROG. NO.=        2
NOS. PER EQ.=       28
NO. OF TERMS=       23
      RUN  11 - 2
NO. OF INPUT LINES=          40
CURR.ERMS= 0.99436894E 02      ADD TERM     4
CURR.ERMS= 0.36234767E 00      ADD TERM    15
CURR.ERMS= 0.27286972E 00      ADD TERM    10
CURR.ERMS= 0.22947199E 00      ADD TERM     5
CURR.ERMS= 0.21939999E 00      ADD TERM     3

T1= 0.16710000E 01 T2= 0.16710000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    3     4     5    10    15

COEFFICIENTS
 0.40642989E-03  0.98711554E 02 -0.70183867E-01  0.51633244E-03  0.46612156E-02

 0.21004859E 00=ERMS              0.21004859E 00=RF.ERMS

SIGMAS
 0.19652862E-03  0.15168748E 00  0.26802207E-01  0.96387796E-04  0.95046921E-03

T'S
 0.20680442E 01  0.64989921E 03 -0.26185853E 01  0.53568238E 01  0.49041206E 01

 0.81483854E 00=RHO               0.66396185E 00=RHO**2
```

```
MULTIPLE REGRESSION
SUBPROG. NO.=        2
NOS. PER EQ.=       28
NO. OF TERMS=       23
      RUN  11 - 2
NO. OF INPUT LINES=          40
MEAN= 0.99436250E 02
S. DEV.= 0.36234767E 00
```

```
MULTIPLE REGRESSION
SUBPROG. NO.=        3
NOS. PER EQ.=       28
NO. OF TERMS=       23
      RUN  11 - 3
NO. OF INPUT LINES=             43
CURR.ERMS= 0.99448078E 02      ADD TERM     4
CURR.ERMS= 0.35978891E 00      ADD TERM    13
CURR.ERMS= 0.27447015E 00      ADD TERM     8
CURR.ERMS= 0.22163395E 00      ADD TERM     5
CURR.ERMS= 0.21181953E 00      ADD TERM     3
CURR.ERMS= 0.20265286E 00      ADD TERM    12
CURR.ERMS= 0.19914438E 00      ADD TERM     6
CURR.ERMS= 0.18299070E 00      ADD TERM    14
CURR.ERMS= 0.16344081E 00      ADD TERM    23
CURR.ERMS= 0.15081996E 00      ADD TERM     7
```

```
MULTIPLE REGRESSION
SUBPROG. NO.=        3
NOS. PER EQ.=       28
NO. OF TERMS=       23
      RUN  11 - 3
NO. OF INPUT LINES=             43
MEAN= 0.99447442E 02
S. DEV.= 0.35978891E 00
```

```
T1= 0.16710000E 01 T2= 0.16710000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    3     4     5     6     7     8    12    13    14    23

COEFFICIENTS
-0.92013408E-03  0.99412261E 02 -0.33793645E 00 -0.20677721E-02  0.78294968E-03
 0.57898047E-03  0.20342312E-02  0.34422630E-02  0.12557638E-01 -0.10071794E-01

 0.14144042E 00=ERMS             0.14144042E 00=RF.ERMS

SIGMAS
 0.40318343E-03  0.24046965E 00  0.45981486E-01  0.34275142E-03  0.32913030E-03
 0.98901227E-04  0.46090571E-03  0.68653311E-03  0.26947387E-02  0.42233384E-02

T'S
-0.22821724E 01  0.41340876E 03 -0.73491025E 01 -0.60328622E 01  0.23788441E 01
 0.58541283E 01  0.50865605E 01  0.50135415E 01  0.46600579E 01 -0.23847944E 01

 0.91948694E 00=RHO              0.84545623E 00=RHO**2
```

```
MULTIPLE REGRESSION
SUBPROG. NO.=          4
NOS. PER EQ.=         28
NO. OF TERMS=         25
        RUN  11 - 4
NO. OF INPUT LINES=               40
CURR.ERMS= 0.99436894E 02       ADD TERM    4
CURR.ERMS= 0.36234767E 00       ADD TERM   15
CURR.ERMS= 0.27286972E 00       ADD TERM   10
CURR.ERMS= 0.22947199E 00       ADD TERM    5
CURR.ERMS= 0.21939909E 00       ADD TERM    3

T1= 0.16710000E 01 T2= 0.16710000E 01 TA= 0.00000000E 00 TB= 0.00000000E 00

TERMS
    3     4     5    10    15

COEFFICIENTS
 0.40642989E-03  0.98711554E 02 -0.70183867E-01  0.51633244E-03  0.46612156E-02

 0.21004859E 00=ERMS                0.21004859E 00=RE.ERMS

SIGMAS
 0.19652862E-03  0.15188748E 00  0.26802217E-01  0.96387796E-04  0.35046921E-03

T'S
 0.20680442E 01  0.64989921E 03 -0.26185853E 01  0.53568238E 01  0.49941266E 01

 0.81483854E 00=RHO                 0.66396165E 00=RHO**2
```

```
MULTIPLE REGRESSION
SUBPROG. NO.=          4
NOS. PER EQ.=         28
NO. OF TERMS=         25
        RUN  11 - 4
NO. OF INPUT LINES=               40
MEAN= 0.99436250E 02
S. DEV.= 0.36234767E 00
```

```
                                                                                     1(

MULTIPLE REGRESSION                                              MULTIPLE REGRESSION
SUBPROG. NO.=        1                                           SUBPROG. NO.=        1
NOS. PER EQ.=       28                                           NOS. PER EQ.=       28
NO. OF TERMS=       21                                           NO. OF TERMS=       21
      RUN  12 - 1                                                      RUN  12 - 1
NO. OF INPUT LINES=           20                                 NO. OF INPUT LINES=           2
CURR.ERMS= 0.99750541E 02      ADD TERM     4                    MEAN= 0.9974   0E 02
CURR.ERMS= 0.13392441E 01      ADD TERM     3                    S. DEV.=  .13392441E
CURR.ERMS= 0.11516906E 01      ADD TERM    15
CURR.ERMS= 0.81712505E 00      ADD TERM     8
CURR.ERMS= 0.75068556E 00      ADD TERM    17
CURR.ERMS= 0.67307204E 00      ADD TERM    19
CURR.ERMS= 0.6 720782E 00      ADD TERM    12

T1= 0.17530000E 01 T2= 0.17530000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    3    4    8   12   15   17   19

COEFFICIENTS
-0.68533971E-01  0.97626938E 02  0.16385291E-02 -0.87246938E-02  0.13714366E 00
-0.26090651E-02  0.11479440E 00

 0.56136635E 00=ERMS           0.56136635E 00=RE.ERMS

SIGMAS
 0.92434446E-02  0.70638 47E 00  0.44313823E-03  0.47457140E-02  0.21950480E-01
 0.10697841E-02  0.49777094E-01

T'S
-0.74143324E 01  0.13817899E 03  0.36975576E 01 -0.18384376E 01  0.62478658E 01
-0.24388708E 01  0.23061692E 01

 0.90790935E 00=RHC            0.82425939E 00=RHC**2
```

```
MULTIPLE REGRESSION                                          MULTIPLE REGRESSION
SUBPROG. NO.=        2                                       SUBPROG. NO.=        2
NOS. PER EQ.=       28                                       NOS. PER EQ.=       28
NO. OF TERMS=       23                                       NO. OF TERMS=       23
       RUN  12 - 2                                                  RUN  12 - 2
NO. OF INPUT LINES=          20                              NO. OF INPUT LINES=          2[illegible]
CURR.ERMS= 0.99750541E 02     ADD TERM    4                  MEAN= 0.9974[illegible]0E 02
CURR.ERMS= 0.13392441E 01     ADD TERM    3                  S. DEV.=  .13392441E [illegible]
CURR.ERMS= 0.11516906E 01     ADD TERM   17
CURR.ERMS= 0.81712505E 00     ADD TERM   10
CURR.ERMS= 0.75068556E 00     ADD TERM   19
CURR.ERMS= 0.67307204E 00     ADD TERM   21
CURR.ERMS= 0.6[illegible]720782E 00     ADD TERM   14

T1= 0.17530000E 01 T2= 0.17530000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    3    4   10   14   17   19   21

COEFFICIENTS
-0.68533971E-01  0.97606938E 02  0.16385291E-02 -0.87246988E-02  0.13714366E 00
-0.26090651E-02  0.11479440E 00

 0.56136635E 00=ERMS           0.56136635E 00=RE.ERMS

SIGMAS
 0.92434446E-[illegible]2  0.70638047E 00  0.44313823E-03  0.47457140E-02  0.21950480E-01
 0.10697841E-0[illegible]  0.49777094E-01

T'S
-0.74143324E 01  0.13817899E 03  0.36975576E 01 -0.18384376E 01  0.62478658E 01
-0.24388708E 01  0.23061692E 01

 0.90790935E 00=RHO            0.82429939E 00=RHO**2
```

```
MULTIPLE REGRESSION
SUBPROG. NO.=       3
NOS. PER EQ.=      28
NO. OF TERMS=      23
      RUN  12 - 3
NO. OF INPUT LINES=         16
CURR.ERMS= 0.99712765E 02     ADD TERM    4
CURR.ERMS= 0.14319810E 01     ADD TERM   17
CURR.ERMS= 0.10234379E 01     ADD TERM   18
CURR.ERMS= 0.81747540E 00     ADD TERM   15
CURR.ERMS= 0.75546405E 00     ADD TERM    3
CURR.ERMS= 0.68283046E 00  REMOVE TERM   17
CURR.ERMS= 0.70007203E 00     ADD TERM    8
CURR.ERMS= 0.56686065E 00  REMOVE TERM   18
CURR.ERMS= 0.57309205E 00     ADD TERM   22
CURR.ERMS= 0.46352664E 00     ADD TERM   16
CURR.ERMS= 0.38067393E 00     ADD TERM   13
CURR.ERMS= 0.34473949E 00     ADD TERM   23
CURR.ERMS= 0.31506935E 00  REMOVE TERM   22
CURR.ERMS= 0.32140889E 00  REMOVE TERM   13

T1= 0.18120000E 01 T2= 0.18120000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    3    4    8   15   16   23

COEFFICIENTS
-0.13158464E 00  0.92735509E 02  0.15962081E-02  0.15711470E 00  0.11742494E 00
-0.70400672E 00

 0.34497918E 00=ERMS           0.34497918E 00=RE.ERMS

SIGMAS
 0.11482071E-01  0.11541937E 01  0.36943349E-03  0.23592336E-01  0.26239203E-01
 0.18378830E 00

T'S
-0.11460010E 02  0.80320581E 02  0.43206913E 01  0.66595655E 01  0.44751717E 01
-0.38305307E 01

 0.97054735E 00=RHO            0.94196216E 00=RHO**2
```

```
MULTIPLE REGRESSION
SUBPROG. NO.=       3
NOS. PER EQ.=      28
NO. OF TERMS=      23
      RUN  12 - 3
NO. OF INPUT LINES=         16
MEAN= 0.99703125E 02
S. DEV.= 0.14319810E 01
```

```
MULTIPLE REGRESSION                                          MULTIPLE REGRESSION
SUBPROG. NO.=       4                                        SUBPROG. NO.=       4
NOS. PER EQ.=      28                                        NOS. PER EQ.=      28
NO. OF TERMS=      25                                        NO. OF TERMS=      25
      RUN  12 - 4                                                  RUN  12 - 4
NO. OF INPUT LINES=          16                              NO. OF INPUT LINES=          16
CURR.ERMS= 0.99712765E 02     ADD TERM    4                  MEAN= 0.99703125E 02
CURR.ERMS= 0.14319810E 01     ADD TERM   19                  S. DEV.= 0.14319810E 01
CURR.ERMS= 0.10234379E 01     ADD TERM   20
CURR.ERMS= 0.81747540E 00     ADD TERM   17
CURR.ERMS= 0.75546405E 00     ADD TERM    3
CURR.ERMS= 0.68283046E 00  REMOVE TERM   19
CURR.ERMS= 0.70007203E 00     ADD TERM   10
CURR.ERMS= 0.56686065E 00  REMOVE TERM   20
CURR.ERMS= 0.57309205E 00     ADD TERM   24
CURR.ERMS= 0.46352664E 00     ADD TERM   18
CURR.ERMS= 0.38067393E 00     ADD TERM   15
CURR.ERMS= 0.34473949E 00     ADD TERM   25
CURR.ERMS= 0.31506935E 00  REMOVE TERM   24
CURR.ERMS= 0.32140889E 00  REMOVE TERM   15

T1= 0.18120000E 01 T2= 0.18120000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    3    4   10   17   18   25

COEFFICIENTS
-0.13158464E 00  0.92755509E 02  0.15962081E-02  0.15711470E 00  0.11742494E 00
-0.70400672E 00

 0.34497918E 00=ERMS            0.34497918E 00=RE.ERMS

SIGMAS
 0.11482071E-01  0.11541937E 01  0.36943349E-03  0.23592336E-01  0.26239203E-01
 0.18378830E 00

T'S
-0.11460010E 02  0.80320581E 02  0.43206913E 01  0.66595655E 01  0.44751717E 01
-0.38305307E 01

 0.97054735E 00=RHO             0.94196216E 00=RHO**2
```

```
MULTIPLE REGRESSION
SUBPROG. NO.=        1
NOS. PER EQ.=       28
NO. OF TERMS=       21
      RUN  13 - 1
NO. OF INPUT LINES=            12
CURR.ERMS= 0.10007935E 03     ADD TERM    14
CURR.ERMS= 0.11459758E 01     ADD TERM    18
CURR.ERMS= 0.98165526E 00     ADD TERM    21
CURR.ERMS= 0.64653002E 00     ADD TERM     9

T1= 0.18600000E 01 T2= 0.18600000E 01 TA= 0.00000000E 00 TB= 0.00000000E 00

TERMS
    9    14    18    21

COEFFICIENTS
 0.13946032E 00  0.10524942E 01 -0.31426091E 00 -0.95986415E 00

 0.50794953E 00=ERMS          0.50794953E 00=RF.ERMS

SIGMAS
 0.53994956E-01  0.41555620E-02  0.63633666E-01  0.18173233E 00

T'S
 0.25828399E 01  0.25327727E 03 -0.49385951E 01 -0.53367726E 01

 0.89639987E 00=RHO           0.80353273E 00=RHO**2
```

```
MULTIPLE REGRESSION
SUBPROG. NO.=        1
NOS. PER EQ.=       28
NO. OF TERMS=       21
      RUN  13 - 1
NO. OF INPUT LINES=            12
MEAN= 0.10007333E 03
S. DEV.= 0.11459758E 01
```

```
MULTIPLE REGRESSION
SUBPROG. NO.=        2
NOS. PER EQ.=       28
NO. OF TERMS=       23
        RUN  13 - 2
NO. OF INPUT LINES=           12
CURR.ERMS= 0.10007933E 03      ADD TERM    16
CURR.ERMS= 0.11459758E 01      ADD TERM    20
CURR.ERMS= 0.98165526E 00      ADD TERM    23
CURR.ERMS= 0.64953002E 00      ADD TERM    11

T1= 0.18600000E 01 T2= 0.18600000E 01 T3= 0.00000000E 00 T4= 0.00000000E 00

TERMS
   11   16   20   23

COEFFICIENTS
 0.13946032E 00  0.10524942E 01 -0.31426091E 00 -0.96986415E 00

 0.50794953E 00=ERMS              0.50794953E 00=RE.ERMS

SIGMAS
 0.53994956E-01  0.41555020E-02  0.63633666E-01  0.18173233E 00

T'S
 0.25828399E 01  0.25327727E 03 -0.49385951E 01 -0.53367726E 01

 0.89639917E 00=RHO               0.80353273E 00=RHO**2
```

```
MULTIPLE REGRESSION
SUBPROG. NO.=        2
NOS. PER EQ.=       28
NO. OF TERMS=       23
        RUN  13 - 2
NO. OF INPUT LINES=           12
MEAN= 0.10007333E 03
S. DEV.= 0.11459758E 01
```

```
MULTIPLE REGRESSION
SUBPROG. NO.=       3
NOS. PER EQ.=      28
NO. OF TERMS=      23
      RUN  13 - 3
NO. OF INPUT LINES=          11
CURR.ERMS= 0.10017330E 03      ADD TERM    14
CURR.ERMS= 0.11524330E 01      ADD TERM    18
CURR.ERMS= 0.79678058E 00      ADD TERM    23
CURR.ERMS= 0.68143637E 00      ADD TERM     9

T1= 0.18950000E 01 T2= 0.18950000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    9    14    18    23

COEFFICIENTS
 0.13877003E 11   0.10522470E 01 -0.30168315E 00 -0.11238690E 01

 0.53463783E 00=ERMS             0.53463783E 00=RF.ERMS

SIGMAS
 0.56850864E-11   0.43938443E-02  0.72932922E-01  0.37919807E 00

T'S
 0.24409484E 01   0.23949129E 03 -0.41227356E 01 -0.29638047E 01

 0.88587659E 00=RHO              0.78477734E 00=RHO**2
```

```
MULTIPLE REGRESSION
SUBPROG. NO.=       3
NOS. PFR EQ.=      28
NO. OF TERMS=      23
      RUN  13 - 3
NO. OF INPUT LINES=          11
MEAN= 0.10016727E 03
S. DEV.= 0.11524330E 01
```

```
MULTIPLE REGRESSION
SUBPROG. NO.=        4
NOS. PER EQ.=       28
NO. OF TERMS=       25
      RUN  13 - 4
NO. OF INPUT LINES=          11
CURR.ERMS= 0.10017330E 03      ADD TERM   16
CURR.ERMS= 0.11524330E 01      ADD TERM   20
CURR.ERMS= 0.79678058E 00      ADD TERM   25
CURR.ERMS= 0.68043637E 00      ADD TERM   11

T1= 0.18950000E 01 T2= 0.18950000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
   11   16   20   25

COEFFICIENTS
 0.13877003E 00  0.10522970E 01 -0.30065315E 00 -0.11238690E 01

 0.53463783E 00=ERMS            0.53463783E 00=RF.ERMS

SIGMAS
 0.56850864E-01  0.43938843E-02  0.72932922E-01  0.37919807E 00

T'S
 0.24409484E 01  0.23949129E 03 -0.41227356E 01 -0.29638047E 01

 0.88587659E 00=RHO             0.78477734E 00=RHO**2
```

```
MULTIPLE REGRESSION
SUBPROG. NO.=        4
NOS. PER EQ.=       28
NO. OF TERMS=       25
      RUN  13 - 4
NO. OF INPUT LINES=          11
MEAN= 0.10016727E 03
S. DEV.= 0.11524330E 01
```

```
MULTIPLE REGRESSION                                              MULTIPLE REGRESSION
SUBPROG. NO.=        1                                           SUBPROG. NO.=        1
NOS. PER EQ.=       28                                           NOS. PER EQ.=       28
NO. OF TERMS=       21                                           NO. OF TERMS=       21
      RUN  14 - 1                                                      RUN  14 - 1
NO. OF INPUT LINES=          8                                   NO. OF INPUT LINES=          8
CURR.ERMS= 0.99255269E 02     ADD TERM    4                      MEAN= 0.99245000E 02
CURR.ERMS= 0.15277715E 01     ADD TERM    3                      S. DEV.= 0.15277715E 01
CURR.ERMS= 0.10122579E 01     ADD TERM   17
CURR.ERMS= 0.70380715E 00     ADD TERM   21
CURR.ERMS= 0.45116389E 00     ADD TERM   18

T1= 0.23530000E 01  T2= 0.23530000E 01  T4= 0.00000000E 00  TR= 0.00000000E 00

TERMS
   3    4    17    18    21

COEFFICIENTS
-0.67597063E-01   0.10474494E 03   0.26579321E-02   0.17223427E 00  -0.96387300E 00

 0.29588578E 00=ERMS               0.29588578E 00=RE.ERMS

SIGMAS
 0.52487323E-02   0.54089124E 00   0.44750328E-03   0.68620067E-01   0.19170298E 00

T'S
-0.12878741E 02   0.19365249E 03   0.59394605E 01   0.25099694E 01  -0.50279499E 01

 0.98100644E 00=RHO                0.96249135E 00=RHO**2
```

```
MULTIPLE REGRESSION
SUBPROG. NO.=        2
NOS. PER EQ.=       28
NO. OF TERMS=       23
      RUN  14 - 2
NO. OF INPUT LINES=              8
CURR.ERMS= 0.99255289E 02      ADD TERM     4
CURR.ERMS= 0.15277715E 01      ADD TERM     3
CURR.ERMS= 0.10022579E 01      ADD TERM    19
CURR.ERMS= 0.70380715E 00      ADD TERM    23
CURR.ERMS= 0.45116389E 00      ADD TERM    20

T1= 0.23530000E 01 T2= 0.23530000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    3     4    19    20    23

COEFFICIENTS
-0.67597063E-01   0.10474494E 03   0.26579321E-02   0.17223427E 00 -0.96387300E 00

 0.29588578E 00=ERMS             0.29588578E 00=RE.ERMS

SIGMAS
 0.52487323E-02   0.54089124E 00   0.44757328E-03   0.68620067E-01   0.19174298E 00

T'S
-0.12878741E 02   0.19365249E 03   0.59384695E 01   0.25099694E 01 -0.50273409E 01

 0.98106644E 00=RHO              0.96249135E 00=RHO**2
```

```
MULTIPLE REGRESSION
SUBPROG. NO.=        2
NOS. PER EQ.=       28
NO. OF TERMS=       23
      RUN  14 - 2
NO. OF INPUT LINES=              8
MEAN= 0.99245000E 02
S. DEV.= 0.15277715E 01
```

```
MULTIPLE REGRESSION
SUBPROG. NO.=          3
NOS. PER EQ.=         25
NO. OF TERMS=         23
        RUN  14 - 3
NO. OF INPUT LINES=                5
CURR.ERRS= 0.6662020E 12        ADD TERM     4
CURR.ERRS= 0.15727587E 01       ADD TERM    16
CURR.ERRS= 0.43372162E 00       ADD TERM    22

T1= 0.29200000E 01 T2= 0.29200000E 01 T4= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    4    16    22

COEFFICIENTS
 0.11938105E 03 -0.24908468E 00 -0.67861503E-03

 0.99820844E-01=ERRS            0.99820844E-01=RE.ERRS

SIGMAS
 0.66134459E 00  0.80095843E-02  0.91794618E-04

T'S
 0.18051262E 03 -0.31173238E 02 -0.73927540E 01

 0.99798383E 00=RHO             0.99597173E 00=RHO**2
```

```
MULTIPLE REGRESSION
SUBPROG. NO.=          3
NOS. PER EQ.=         28
NO. OF TERMS=         23
        RUN  14 - 3
NO. OF INPUT LINES=                5
MEAN= 0.98682000E 02
S. DEV.= 0.15727587E 01
```

```
MULTIPLE REGRESSION
SUBPROG. NO.=        4
NOS. PER EQ.=       28
NO. OF TERMS=       25
        RUN  14 - 4
NO. OF INPUT LINES=          5
CURR.ERMS= 0.98682026E 02      ADD TERM    4
CURR.ERMS= 0.15727587E 01      ADD TERM   18
CURR.ERMS= 0.43379182E 00      ADD TERM   24

T1= 0.29200000E 01 T2= 0.29200000E 01 T3= 0.00000000E 00 T4= 0.00000000E 00

TERMS
    4    18    24

COEFFICIENTS
 0.11938105E 03 -0.24965468E 00 -0.67861503E-03

 0.99820844E-01=ERMS            0.99820844E-01=RE.ERMS

SIGMAS
 0.66134459E 00  0.80095543E-02  0.91796618E-04

T'S
 0.18051262E 03 -0.31173238E 02 -0.73927540E 01

 0.99796383E 00=RHO             0.99597173E 00=RHO**2
```

```
MULTIPLE REGRESSION
SUBPROG. NO.=        4
NOS. PER EQ.=       28
NO. OF TERMS=       25
        RUN  14 - 4
NO. OF INPUT LINES=          5
MEAN= 0.98682000E 02
S. DEV.= 0.15727587E 01
```

```
MULTIPLE REGRESSION                                              MULTIPLE REGRESSION
SUBPROG. NO.=         1                                          SUBPROG. NO.=         1
NOS. PER EQ.=        28                                          NOS. PER EQ.=        28
NO. OF TERMS=        21                                          NO. OF TERMS=        21
CONSTANT TERM                                                    CONSTANT TERM
      RUN  15 - 1                                                      RUN  15 - 1
NO. OF INPUT LINES=          831                                 NO. OF INPUT LINES=          831
CURR.ERMS= 0.16652771E 01      ADD TERM     6                    MEAN= 0.99278700E 02
CURR.ERMS= 0.16160582E 01      ADD TERM    13                    S. DEV.= 0.16652771E 01
CURR.ERMS= 0.16039102E 01      ADD TERM    21
CURR.ERMS= 0.15934335E 01      ADD TERM     5
CURR.ERMS= 0.15839707E 01      ADD TERM     1
CURR.ERMS= 0.15791294E 01      ADD TERM     8
CURR.ERMS= 0.15751366E 01      ADD TERM     7
CURR.ERMS= 0.15728029E 01      ADD TERM    20
CURR.ERMS= 0.15712608E 01      ADD TERM    14
CURR.ERMS= 0.15696806E 01      ADD TERM    17

T1= 0.16450000E 01 T2= 0.16450000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    C    1    5    6    7    8   13   14   17   20   21

COEFFICIENTS
 0.10075564E 03  0.22287582E-02 -0.51267335E-01 -0.21401815E-02 -0.10787764E-02
-0.65104855E-03  0.36013396E-02 -0.59262395E-03  0.85217700E-05 -0.67303009E-01
-0.46018157E-01

 0.15660942E 01=ERMS            0.15660942E 01=RF.ERMS

SIGMAS
 0.27313750E 00  0.61448673E-03  0.22523589E-01  0.27341809E-03  0.43735614E-03
 0.25975955E-03  0.75377638E-03  0.22247148E-03  0.39041161E-05  0.30831918E-01
 0.92495760E-02

T'S
 0.36888249E 03  0.36270242E 01 -0.22761619E 01 -0.78275051E 01 -0.24665557E 01
-0.25063498E 01  0.47777167E 01 -0.26638199E 01  0.21827655E 01 -0.21391175E 01
-0.49751540E 01

 0.33995807E 00=RHO             0.11557149E 00=RHO**2
```

```
MULTIPLE REGRESSION                                            MULTIPLE REGRESSION
SUBPROG. NO.=        2                                         SUBPROG. NO.=        2
NOS. PER EQ.=       28                                         NOS. PER EQ.=       28
NO. OF TERMS=       23                                         NO. OF TERMS=       23
       RUN  15 - 2                                                    RUN  15 - 2
NO. OF INPUT LINES=          299                               NO. OF INPUT LINES=          299
CURR.ERMS= 0.34797654E 00      ADD TERM   10                   MEAN= 0.99316355E 02
CURR.ERMS= 0.32218434E 00      ADD TERM    8                   S. DEV.= 0.34797654E 00
CURR.ERMS= 0.29887375E 00      ADD TERM   23
CURR.ERMS= 0.29468831E 00      ADD TERM   15
CURR.ERMS= 0.29234250E 00      ADD TERM    9

T1= 0.16450000E 01 T2= 0.16450000E 01 T4= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    C    8    9   10   15   23

COEFFICIENTS
 0.99318677E 02 -0.65468639E-03 -0.29565173E-03  0.54764233E-03  0.64057772E-03
-0.67348882E-02

 0.29070152E 00=ERMS             0.29070152E 00=RE.ERMS

SIGMAS
 0.55453814E-01  0.89962499E-04  0.14210447E-03  0.80210993E-04  0.21891150E-03
 0.20115959E-02

T'S
 0.17906932E 04 -0.72773255E 01 -0.20805238E 01  0.68275222E 01  0.29261950E 01
-0.33480323E 01

 0.54963409E 00=RHO              0.30209763E 00=RHO**2
```

```
MULTIPLE REGRESSION                                            MULTIPLE REGRESSION
SUBPROG. NO.=        3                                         SUBPROG. NO.=        3
NOS. PER EQ.=       28                                         NOS. PER EQ.=       28
NO. OF TERMS=       23                                         NO. OF TERMS=       23
      RUN  15 - 3                                                    RUN  15 - 3
NO. OF INPUT LINES=           732                              NO. OF INPUT LINES=         732
CURR.ERMS= 0.17704542E 01      ADD TERM    6                   MEAN= 0.99280628E 02
CURR.ERMS= 0.17131887E 01      ADD TERM   13                   S. DEV.= 0.17704542E 01
CURR.ERMS= 0.17005525E 01      ADD TERM   23
CURR.ERMS= 0.16884424E 01      ADD TERM    5
CURR.ERMS= 0.16787332E 01      ADD TERM    1
CURR.ERMS= 0.16744037E 01      ADD TERM    8
CURR.ERMS= 0.16696694E 01      ADD TERM   12
CURR.ERMS= 0.16670517E 01      ADD TERM    7

T1= 0.16450000E 01 T2= 0.16450000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    0     1     5     6     7     8    12    13    23

COEFFICIENTS
 0.10071696E 03  0.19667744E-02 -0.76269439E-01 -0.21298053E-02 -0.75811457E-03
-0.79727754E-03  0.11224014E-02  0.31452671E-02 -0.50187124E-01

 0.16651836E 01=ERMS              0.16651836E 01=RE.ERMS

SIGMAS
 0.30057807E 00  0.67095055E-03  0.25285290E-01  0.29887526E-03  0.46788526E-03
 0.29874636E-03  0.68967897E-03  0.79284176E-03  0.10824693E-01

T'S
 0.33507754E 03  0.29313254E 01 -0.30160002E 01 -0.71260678E 01 -0.16203002E 01
-0.26687439E 01  0.16274259E 01  0.39670805E 01 -0.46363556E 01

 0.33968194E 00=RHO               0.11538382E 00=RHO**2
```

```
MULTIPLE REGRESSION
SUBPROG. NO.=         4
NOS. PER EQ.=        28
NO. OF TERMS=        25
      RUN  15 - 4
NO. OF INPUT LINES=           268
CURR.ERMS= 0.35591974E 00        ADD TERM    10
CURR.ERMS= 0.32922857E 00        ADD TERM     8
CURR.ERMS= 0.30226475E 00        ADD TERM    25
CURR.ERMS= 0.29764746E 00        ADD TERM    15
CURR.ERMS= 0.29484402E 00        ADD TERM     4
CURR.ERMS= 0.29316594E 00        ADD TERM     1
CURR.ERMS= 0.28601424E 00        ADD TERM     9
CURR.ERMS= 0.28518379E 00        ADD TERM     3
CURR.ERMS= 0.28422375E 00        ADD TERM     6
CURR.ERMS= 0.28216462E 00        ADD TERM     7
CURR.ERMS= 0.28041915E 00     REMOVE TERM     9
CURR.ERMS= 0.28115118E 00        ADD TERM    23

T1= 0.16450000E 01 T2= 0.16450000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    C     1     3     4     6     7     8    10    15    23    25

COEFFICIENTS
 0.98692610E 02  0.10855527E-02 -0.10117121E-03  0.10901399E 00 -0.32990751E-02
 0.22649343E-02 -0.58307970E-03  0.52151055E-03  0.12029150E-02 -0.77086740E-03
-0.90762622E-02

 0.28005444E 00=ERMS               0.28005444E 00=RE.ERMS

SIGMAS
 0.14158883E 00  0.26834791E-03  0.33796500E-04  0.20658504E-01  0.10493127E-02
 0.83852661E-03  0.98902713E-04  0.88683637E-04  0.26506673E-03  0.44324063E-03
 0.28641535E-02

T'S
 0.69703669E 03  0.40453181E 01 -0.29943684E 01  0.52769546E 01 -0.31440343E 01
 0.27010881E 01 -0.58954874E 01  0.58802409E 01  0.45381593E 01 -0.17391623E 01
-0.31689161E 01

 0.61714780E 00=RHO                0.38037152E 00=RHO**2
```

```
MULTIPLE REGRESSION
SUBPROG. NO.=         4
NOS. PER EQ.=        28
NO. OF TERMS=        25
      RUN  15 - 4
NO. OF INPUT LINES=           268
MEAN= 0.99327761E 02
S. DEV.= 0.35591974E 00
```

```
MULTIPLE REGRESSION                                           MULTIPLE REGRESSION
SUBPROG. NO.=        1                                        SUBPROG. NO.=        1
NOS. PER EQ.=       28                                        NOS. PER EQ.=       28
NO. OF TERMS=       21                                        NO. OF TERMS=       21
      RUN  16 - 1                                                   RUN  16 - 1
NO. OF INPUT LINES=        451                                NO. OF INPUT LINES=        451
CURR.ERMS= 0.99272703E 02     ADD TERM   10                   MEAN= 0.99257472E 02
CURR.ERMS= 0.17408012E 01     ADD TERM    6                   S. DEV.=  .174.80128  1
CURR.ERMS= 0.17055680E 01     ADD TERM    2
CURR.ERMS= 0.16923410E 01     ADD TERM   21
CURR.ERMS= 0.16871727E 01     ADD TERM    1
CURR.ERMS= 0.16797943E 01     ADD TERM    8
CURR.ERMS= 0.16582152E 01     ADD TERM   20
CURR.ERMS= 0.16511439E 01     ADD TERM   13
CURR.ERMS= 0.16476849E 01     ADD TERM    5
CURR.ERMS= 0.16445709E 01     ADD TERM   12

T1= 0.16450000E 01 T2= 0.16450000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    1    2    5    6    8   10   12   13   20   21

COEFFICIENTS
 0.33939049E-02  0.55109544E-01 -0.55299943E-01 -0.15195091E-02 -0.16827756E-02
 0.48519825E 02  0.14075348E-02  0.22464632E-02 -0.17650445E 00 -0.55431155E-01

 0.16414471E 01=ERMS           0.16414471E 01=RE.ERMS

SIGMAS
 0.95784615E-03  0.24117247E-01  0.30705558E-01  0.38070952E-03  0.42956975E-03
 0.76325477E 00  0.85916750E-03  0.10991138E-02  0.82576447E-01  0.12867126E-01

T'S
 0.35432673E 01  0.22850678E 01 -0.18009750E 01 -0.39912559E 01 -0.39173512E 01
 0.63569631E 02  0.16382542E 01  0.20438860E 01 -0.21374672E 01 -0.43079670E 01

 0.33300159E 00=RHC            0.11089006E 00=RHC**2
```

```
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MULTIPLE REGRESSION                                    MULTIPLE REGRESSION
SUBPROG. NO.=       2                                  SUBPROG. NO.=       2
NOS. PER EQ.=      28                                  NOS. PER EQ.=      28
NO. OF TERMS=      23                                  NO. OF TERMS=      23
      RUN  16 - 2                                            RUN  16 - 2
NO. OF INPUT LINES=         88                         NO. OF INPUT LINES=         88
CURR.ERMS= 0.99305835E 02    ADD TERM   12             MEAN= 0.99305341E 02
CURR.ERMS= 0.31501851E 00    ADD TERM   23             S. DEV.=  .3151851E
CURR.ERMS= 0.30259278E 00    ADD TERM    8
CURR.ERMS= 0.26871882E 00    ADD TERM    1
CURR.ERMS= 0.25554557E 00    ADD TERM   22

T1= 0.16580000E 01 T2= 0.16580000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    1    8   12   22   23

COEFFICIENTS
 0.15763878E-02 -0.93502902E-03  0.49749774E 02 -0.58834227E-01 -0.20270356E-01

 0.25063369E 00=ERMS           0.25063369E 00=RE.ERMS

SIGMAS
 0.43508781E-03  0.15870659E-03  0.37869250E-01  0.28291244E-01  0.33264960E-02

T'S
 0.36231486E 01 -0.58915576E 01  0.13137248E 04 -0.20795914E 01 -0.60936059E 01

 0.60580159E 00=RHO            0.36699557E 00=RHO**2
```

```
MULTIPLE REGRESSION                                               MULTIPLE REGRESSION
SUBPROG. NO.=      3                                              SUBPROG. NO.=      3
NOS. PER EQ.=     28                                              NOS. PER EQ.=     28
NO. OF TERMS=     23                                              NO. OF TERMS=     23
      RUN  16 - 3                                                       RUN  16 - 3
NO. OF INPUT LINES=          389                                  NO. OF INPUT LINES=         389
CURR.ERMS= 0.99281772E 02      ADD TERM   10                      MEAN= 0.99264190E 02
CURR.ERMS= 0.18707499E 01      ADD TERM    6                      S. DEV.= 0.18707499E 01
CURR.ERMS= 0.18306027E 01      ADD TERM   22
CURR.ERMS= 0.18098521E 01      ADD TERM    1
CURR.ERMS= 0.17857046E 01      ADD TERM   23
CURR.ERMS= 0.17628675E 01      ADD TERM    8
CURR.ERMS= 0.17560548E 01      ADD TERM   20
CURR.ERMS= 0.17493874E 01      ADD TERM   13
CURR.ERMS= 0.17438524E 01      ADD TERM   18

T1= 0.16450000E 01 T2= 0.16450000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    1     6     8    10    13    18    20    22    23

COEFFICIENTS
 0.52358090E-02 -0.14089027E-02 -0.11447465E-02  0.50121287E 02  0.22410925E-02
-0.21366321E-01 -0.20630823E 00 -0.11864779E-02 -0.60435698E-01

 0.17398478E 01=ERMS            0.17398478E 01=RE.ERMS

SIGMAS
 0.10694409E-02  0.40382266E-03  0.48738745E-03  0.14580480E 00  0.11796770E-02
 0.12870564E-01  0.94898380E-01  0.29730151E-03  0.15437821E-01

T'S
 0.48958376E 01 -0.34889144E 01 -0.23487402E 01  0.34375608E 03  0.18997510E 01
-0.16600921E 01 -0.21739911E 01 -0.39975509E 01 -0.39147616E 01

 0.36749135E 00=RHO             0.13504989E 00=RHO**2
```

```
MULTIPLE REGRESSION                                                   MULTIPLE REGRESSION
SUBPROG. NO.=        4                                                SUBPROG. NO.=        4
NOS. PER EQ.=       28                                                NOS. PER EQ.=       28
NO. OF TERMS=       25                                                NO. OF TERMS=       25
      RUN  16 - 4                                                           RUN  16 - 4
NO. OF INPUT LINES=           70                                      NO. OF INPUT LINES=           70
CURR.ERMS= 0.99336670E 02     ADD TERM   12                           MEAN= 0.99336143E 02
CURR.ERMS= 0.32595586E 00     ADD TERM    5                           S. DEV.= 0.32595586E 00
CURR.ERMS= 0.31021346E 00     ADD TERM   25
CURR.ERMS= 0.29203679E 00     ADD TERM    8
CURR.ERMS= 0.27782323E 00  REMOVE TERM    5
CURR.ERMS= 0.27854131E 00     ADD TERM   10
CURR.ERMS= 0.25791784E 00     ADD TERM   17
CURR.ERMS= 0.24756217E 00     ADD TERM   22

T1= 0.16580000E 01 T2= 0.16580000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    8   10   12   17   22   25

COEFFICIENTS
-0.16494699E-02  0.90234988E-03  0.48509081E 02  0.21494734E-01 -0.58512387E-01
-0.79794488E-02

 0.24273882E 00=ERMS           0.24273882E 00=RE.ERMS

SIGMAS
 0.25287275E-03  0.20066118E-03  0.41565594E 00  0.73594324E-02  0.30800966E-01
 0.44541283E-02

T'S
-0.65229245E 01  0.44968831E 01  0.11670489E 03  0.29207054E 01 -0.18996932E 01
-0.17914726E 01

 0.66740112E 00=RHO            0.44542425E 00=RHO**2
```

```
JULY 11,74  RPLFSC2 FORTRAN.                                            CR  7..42
*      HE 415 LILA --LINC  BLDG 328 X4540                                          *

MULTIPLE REGRESSION                                      MULTIPLE REGRESSION
SUBPROG. NO.=        1                                   SUBPROG. NO.=        1
NOS. PER EQ.=       28                                   NOS. PER EQ.=       29
NO. OF TERMS=       21                                   NO. OF TERMS=       21
      RUN  17 - 1                                              RUN  17 - 1
NO. OF INPUT LINES=          656                         NO. OF INPUT LINES=          656
CURR.ERMS= 0.18645861E 01      ADD TERM    6             MEAN= 0.99267337E 02
CURR.ERMS= 0.17979351E 01      ADD TERM   13             S. DEV.= 0.18645861E 01
CURR.ERMS= 0.17801119E 01      ADD TERM    5
CURR.ERMS= 0.17698660E 01      ADD TERM   21
CURR.ERMS= 0.17600398E 01      ADD TERM    1
CURR.ERMS= 0.17545151E 01      ADD TERM    8
CURR.ERMS= 0.17412968E 01      ADD TERM   20
CURR.ERMS= 0.17341689E 01      ADD TERM    7
CURR.ERMS= 0.17298425E 01      ADD TERM   14
CURR.ERMS= 0.17263799E 01      ADD TERM   17

T1= 0.16450000E 01 T2= 0.16450000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
   C    1    5    6    7    8   13   14   17   20   21

COEFFICIENTS
 0.10119837E 03  0.34081678E-02 -0.48349663E-01 -0.23348915E-02 -0.17121684E-02
-0.13392445E-02  0.48711811E-02 -0.99271932E-03  0.13003424E-04 -0.19406829E 00
-0.58836068E-01

 0.17165440E 01=ERMS           0.17165440E 01=RF.ERMS

SIGMAS
 0.32749930E 00  0.78623642E-03  0.27338745E-01  0.32988824E-03  0.54577735E-03
 0.33654269E-03  0.99457699E-03  0.26075701E-03  0.44800962E-05  0.71979107E-01
 0.11816274E-01

T'S
 0.30900334E 03  0.43347875E 01 -0.17685034E 01 -0.70778258E 01 -0.31167963E 01
-0.39794193E 01  0.48977416E 01 -0.34235679E 01  0.29024877E 01 -0.26961753E 01
-0.49792401E 01

 0.39049924E 00=RHO            0.15248966E 00=RHO**2
```

```
MULTIPLE REGRESSION
SUBPROG. NO.=        2
NOS. PER EQ.=       28
NO. OF TERMS=       23
      RUN  17 - 2
NO. OF INPUT LINES=          132
CURR.ERMS= 0.31388221E 00      ADD TERM    8
CURR.ERMS= 0.30086201E 00      ADD TERM   10
CURR.ERMS= 0.26787979E 00      ADD TERM   23
CURR.ERMS= 0.26213383E 00      ADD TERM    1

T1= 0.16450000E 01 T2= 0.16450000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    C    1    8   10   23

COEFFICIENTS
 0.99353389E 02  0.10911771E-02 -0.88268839E-03  0.29597940E-03 -0.13736824E-01

 0.25713481E 00=ERMS           0.25713481E 00=RF.ERMS

SIGMAS
 0.74127683E-01  0.44453385E-03  0.12990712E-03  0.16381513E-03  0.38239537E-02

T'S
 0.13403008E 04  0.24546548E 01 -0.67947652E 01  0.18067892E 01 -0.35923093E 01

 0.57349655E 00=RHO            0.32889829E 00=RHO**2
```

```
MULTIPLE REGRESSION
SUBPROG. NO.=        2
NOS. PER EQ.-       28
NO. OF TERMS=       23
      RUN  17 - 2
NO. OF INPUT LINES=          132
MEAN= 0.99319697E 02
S. DEV.= 0.31388221E 00
```

```
MULTIPLE REGRESSION                                          MULTIPLE REGRESSION
SUBPROG. NO.=        3                                       SUBPROG. NO.=        3
NOS. PER EQ.=       28                                       NOS. PER EQ.=       28
NO. OF TERMS=       23                                       NO. OF TERMS=       23
      RUN   17 - 3                                                 RUN   17 - 3
NO. OF INPUT LINES=          561                             NO. OF INPUT LINES=          561
CURR.ERMS= 0.20121938E 01      ADD TERM    6                 MEAN= 0.99269251E 02
CURR.ERMS= 0.19319586E 01      ADD TERM   13                 S. DEV.= 0.20121938E 01
CURR.ERMS= 0.19113443E 01      ADD TERM   23
CURR.ERMS= 0.19009235E 01      ADD TERM    5
CURR.ERMS= 0.18901685E 01      ADD TERM    1
CURR.ERMS= 0.18853515E 01      ADD TERM    8
CURR.ERMS= 0.18688500E 01      ADD TERM   20
CURR.ERMS= 0.18597073E 01      ADD TERM   12
CURR.ERMS= 0.18546603E 01      ADD TERM    7

T1= 0.16450000E 01 T2= 0.16450000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    C    1    5    6    7    8   12   13   20   23

COEFFICIENTS
 0.10110037E 03  0.33925967E-02 -0.80081462E-01 -0.22283886E-02 -0.10838101E-02
-0.16437208E-02  0.16757678E-02  0.43225705E-02 -0.19763965E 00 -0.65438109E-01

 0.18508826E 01=ERMS            0.18508826E 01=RF.ERMS

SIGMAS
 0.37829408E 00  0.95709359E-03  0.30860079E-01  0.36790131E-03  0.60067255E-03
 0.40239444E-03  0.88306868E-03  0.10761984E-02  0.84638196E-01  0.14702627E-01

T'S
 0.26725337E 03  0.35446864E 01 -0.25949857E 01 -0.60570282E 01 -0.18043276E 01
-0.40848497E 01  0.18976642E 01  0.40165182E 01 -0.23351116E 01 -0.44507766E 01

 0.39230977E 00=RHO             0.15390696E 00=RHO**2
```

```
MULTIPLE REGRESSION                                          MULTIPLE REGRESSION
SUBPROG. NO.=        4                                       SUBPROG. NO.=        4
NOS. PER EQ.=       28                                       NOS. PER EQ.=       28
NO. OF TERMS=       25                                       NO. OF TERMS=       25
     RUN  17 - 4                                                  RUN  17 - 4
NO. OF INPUT LINES=          105                             NO. OF INPUT LINES=          105
CURR.ERMS= 0.32459293E 00      ADD TERM    8                 MEAN= 0.99357228E 02
CURR.ERMS= 0.31214483E 00      ADD TERM   10                 S. DEV.=  .32459293E
CURR.ERMS= 0.26043873E 00      ADD TERM   17
CURR.ERMS= 0.25376771E 00      ADD TERM   13
CURR.ERMS= 0.24970840E 00      ADD TERM   22
CURR.ERMS= 0.24664696E 00      ADD TERM    4

T1= 0.16580000E 01 T2= 0.16580000E 01 TA= 0.00000000E 00 IR= 0.00000000E 00

TERMS
    C    4    8   10   13   17   22

COEFFICIENTS
 0.96590183E 02  0.12378955E 00 -0.14408454E-02  0.12050367E-02 -0.59107360E-01
 0.18768767E-01 -0.49283949E-01

 0.24487015E 00=ERMS             0.24487015E 00=RF.ERMS

SIGMAS
 0.87966678E 00  0.79211070E-01  0.19833793E-03  0.15342962E-03  0.27510681E-01
 0.58518680E-02  0.25638260E-01

T'S
 0.10980315E 03  0.15626674E 01 -0.72645981E 01  0.78552270E 01 -0.19361500E 01
 0.32073120E 01 -0.19222814E 01

 0.65642475E 00=RHO              0.43089345E 00=RHO**2
```

```
MULTIPLE REGRESSION                                                MULTIPLE REGRESSION
SUBPROG. NO.=        1                                              SUBPROG. NO.=        1
NOS. PER EQ.=       28                                              NOS. PER EQ.=       28
NO. OF TERMS=       21                                              NO. OF TERMS=       21
      RUN  18 - 1                                                         RUN  18 - 1
NO. OF INPUT LINES=          175                                    NO. OF INPUT LINES=          175
CURR.ERMS= 0.99323140E 02       ADD TERM     4                      MEAN= 0.99322457E 02
CURR.ERMS= 0.37187042E 00       ADD TERM     8                      S. DEV.= 0.37187042E 00
CURR.ERMS= 0.33103150E 00       ADD TERM     6
CURR.ERMS= 0.31667332E 00       ADD TERM    13
CURR.ERMS= 0.313[illegible]E 00       ADD TERM     7
CURR.ERMS= 0.30[illegible]E 00       ADD TERM     5
CURR.ERMS= 0.29666095E 00       ADD TERM     1
CURR.ERMS= 0.29463606E 00       ADD TERM    11
CURR.ERMS= 0.29060833E 00       ADD TERM    21
CURR.ERMS= 0.28657505E 00       ADD TERM    16
CURR.ERMS= 0.28619168E 00    REMOVE TERM     5
CURR.ERMS= 0.28675566E 00       ADD TERM    14
CURR.ERMS= 0.27432612E 00    REMOVE TERM     7

T1= 0.16450000E 01 T2= 0.16450000E 01 IA= 0.00000000E 00 IB= 0.00000000E 00

TERMS
     1     4     6     8    11    13    14    16    21

COEFFICIENTS
 0.79047845E-03  0.99613261E 02 -0.57780023E-03  0.65524577E-03  0.31952134E-01
 0.11436627E-02  0.11935423E-01 -0.41937327E-01 -0.54786746E-02

 0.27382170E 00=ERMS             0.27382170E 00=RF.ERMS

SIGMAS
 0.34939545E-03  0.26449904E 00  0.11193458E-03  0.98897662E-04  0.15273917E-01
 0.35479368E-03  0.21738163E-02  0.73955661E-02  0.32339397E-02

T'S
 0.22624175E 01  0.37661097E 03 -0.51624816E 01  0.66254930E 01  0.20919211E 01
 0.32235148E 01  0.54951399E 01 -0.56707393E 01 -0.16941178E 01

 0.67661569E 00=R             0.45780878E 00=RHO**2
```

```
MULTIPLE REGRESSION
SUBPROG. NO.=        2
NOS. PER EQ.=       28
NO. OF TERMS=       23
      RUN  18 - 2
NO. OF INPUT LINES=          167
CURR.ERMS= 0.99314411E 02        ADD TERM     4
CURR.ERMS= 0.37364291E 00        ADD TERM    10
CURR.ERMS= 0.33505920E 00        ADD TERM     8
CURR.ERMS= 0.32032307E 00        ADD TERM    15
CURR.ERMS= 0.31363186E 00        ADD TERM     9
CURR.ERMS= 0.30773115E 00        ADD TERM     5
CURR.ERMS= 0.30020920E 00        ADD TERM     1
CURR.ERMS= 0.29780655E 00        ADD TERM    13
CURR.ERMS= 0.29418386E 00        ADD TERM    23
CURR.ERMS= 0.29221544E 00        ADD TERM    18
CURR.ERMS= 0.29061309E 00     REMOVE TERM     5
CURR.ERMS= 0.29015120E 00        ADD TERM    16
CURR.ERMS= 0.27798020E 00     REMOVE TERM     9

T1= 0.16450000E 01 T2= 0.16450000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    1     4     6    10    13    15    16    18    23

COEFFICIENTS
 0.78634706E-03  0.99600322E 02 -0.58160101E-03  0.65926127E-03  0.31145256E-01
 0.11241978E-02  0.11987358E-01 -0.41837772E-01 -0.53060133E-02

 0.27753108E 00=ERMS            0.27753108E 00=RF.ERMS

SIGMAS
 0.36154600E-03  0.27113569E 00  0.11581067E-03  0.10783235E-03  0.15675368E-01
 0.36383142E-03  0.22309516E-02  0.75900697E-02  0.33796674E-02

T'S
 0.21749572E 01  0.36734507E 03 -0.50189647E 01  0.61137616E 01  0.20060298E 01
 0.30898865E 01  0.53732036E 01 -0.55121723E 01 -0.15699809E 01

 0.66954556E 00=RHO             0.44829139E 00=RHO**2


MULTIPLE REGRESSION
SUBPROG. NO.=        2
NOS. PER EQ.=       28
NO. OF TERMS=       23
      RUN  18 - 2
NO. OF INPUT LINES=          167
MEAN= 0.99313713E 02
S. DEV.= 0.37364291E 00
```

```
MULTIPLE REGRESSION                                          MULTIPLE REGRESSION
SUBPROG. NO.=        3                                       SUBPROG. NO.=        3
NOS. PER EQ.=       28                                       NOS. PER EQ.=       28
NO. OF TERMS=       23                                       NO. OF TERMS=       23
      RUN  18 - 3                                                  RUN  18 - 3
NO. OF INPUT LINES=          171                             NO. OF INPUT LINES=          171
CURR.ERMS= 0.99318649E 02      ADD TERM     4                MEAN= 0.99317953E 02
CURR.ERMS= 0.37272434E 00      ADD TERM     8                S. DEV.= 0.37272434E 00
CURR.ERMS= 0.33013[illegible]E 00      ADD TERM     6
CURR.ERMS= 0.31558365E 00      ADD TERM    13
CURR.ERMS= 0.30862816E 00      ADD TERM     7
CURR.ERMS= 0.30284054E 00      ADD TERM     5
CURR.ERMS= 0.29553332E 00      ADD TERM     1
CURR.ERMS= 0.29323277E 00      ADD TERM    11
CURR.ERMS= 0.29060688E 00      ADD TERM    23

T1= 0.16450000E 01 T2= 0.16450000E 01 TA= 0.00000000E 00 TB= 0.00000000E 00

TERMS
    1    4    5    6    7    8   11   13   23

COEFFICIENTS
 0.10429756E-02  0.98876951E 02 -0.28075043E-01 -0.68417962E-03 -0.78665398E-03
 0.67792558E-03  0.35591087E-01  0.20637798E-02 -0.57249866E-02

 0.28851035E 00=ERMS            0.28851035E 00=RE.ERMS

SIGMAS
 0.37917195E-03  0.26032693E 00  0.13247639E-01  0.14863191E-03  0.23114582E-03
 0.11484660E-03  0.16301947E-01  0.38877789E-03  0.34418553E-02

T'S
 0.27506667E 01  0.37981837E 03 -0.21192487E 01 -0.46031812E 01 -0.34032801E 01
 0.59028787E 01  0.21832906E 01  0.53083775E 01 -0.16633438E 01

 0.63311439E 00=RHO             0.40083343E 00=RHO**2
```

```
MULTIPLE REGRESSION                                         MULTIPLE REGRESSION
SUBPROG. NO.=        4                                      SUBPROG. NO.=        4
NOS. PER EQ.=       28                                      NOS. PER EQ.=       28
NO. OF TERMS=       25                                      NO. OF TERMS=       25
     RUN  18 - 4                                                 RUN  18 - 4
NO. OF INPUT LINES=        163                              NO. OF INPUT LINES=        163
CURR.ERMS= 0.99309475E 02     ADD TERM    4                 MEAN= 0.99308773E 02
CURR.ERMS= 0.37446056E 00     ADD TERM   10                 S. DEV.= 0.37446056E 00
CURR.ERMS= 0.33410191E 00     ADD TERM    8
CURR.ERMS= 0.31916560E 00     ADD TERM   15
CURR.ERMS= 0.31163421E 00     ADD TERM    9
CURR.ERMS= 0.30549276E 00     ADD TERM    5
CURR.ERMS= 0.29875463E 00     ADD TERM    1
CURR.ERMS= 0.29624765E 00     ADD TERM   13
CURR.ERMS= 0.29346604E 00     ADD TERM   25

T1= 0.16450000E 01 T2= 0.16450000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    1    4    5    8    9   10   13   15   25

COEFFICIENTS
 0.10819963E-02  0.98828148E 02 -0.24898136E-01 -0.66961493E-03 -0.79502435E-03
 0.67816654E-03  0.34399265E-01  0.20758106E-02 -0.56060208E-02

 0.29210777E 00=ERMS             0.29210777E 00=RE.ERMS

SIGMAS
 0.39358218E-03  0.26649448E 00  0.13652380E-01  0.15367740E-03  0.23857119E-03
 0.12437685E-03  0.16729226E-01  0.39792999E-03  0.35853477E-02

T'S
 0.27490988E 01  0.37084502E 03 -0.18237213E 01 -0.43572766E 01 -0.33324407E 01
 0.54525143E 01  0.20562376E 01  0.52165220E 01 -0.15635919E 01

 0.62568450E 00=RHO              0.39148109E 00=RHO**2
```

```
MULTIPLE REGRESSION
SUBPROG. NO.=        1
NOS. PER EQ.=       28
NO. OF TERMS=       21
      RUN  19 - 1
NO. OF INPUT LINES=          30
CURR.ERMS= 0.99168324E 02       ADD TERM    16
CURR.ERMS= 0.36722382E 00       ADD TERM     8
CURR.ERMS= 0.30654584E 00       ADD TERM     6

T1= 0.16970000E 01 T2= 0.16970000E 01 TA= 0.00000000E 00 TR= 0.10000000E 00

TERMS
    6     8    16

COEFFICIENTS
-0.79459944E-03  0.11369017E-02  0.20623378E 01

 0.29880140E 00=ERMS             0.29880140E 00=RE.ERMS

SIGMAS
 0.50556732E-03  0.36546530E-03  0.19931332E-02

T'S
-0.15716986E 01  0.31106633E 01  0.10347215E 04

 0.58131790E 00=RHO              0.33793050E 00=RHO**2
```

```
MULTIPLE REGRESSION
SUBPROG. NO.=        1
NOS. PER EQ.=       28
NO. OF TERMS=       21
      RUN  19 - 1
NO. OF INPUT LINES=          30
MEAN= 0.99168667E 02
S. DEV.= 0.36722382E 00
```

```
MULTIPLE REGRESSION                                              MULTIPLE REGRESSION
SUBPROG. NO.=        2                                           SUBPROG. NO.=        2
NOS. PER EQ.=       28                                           NOS. PER EQ.=       28
NO. OF TERMS=       23                                           NO. OF TERMS=       23
     RUN  19 - 2                                                      RUN  19 - 2
NO. OF INPUT LINES=          30                                  NO. OF INPUT LINES=          30
CURR.ERMS= 0.99168324E 02      ADD TERM   18                     MEAN= 0.99168067E 02
CURR.ERMS= 0.36722382E 00      ADD TERM   10                     S. DEV.= 0.36722382E 00
CURR.ERMS= 0.31665664E 00      ADD TERM    8

T1= 0.16970000E 01 T2= 0.16970000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    8    10    18

COEFFICIENTS
-0.79459944E-03  0.11369917E-02  0.20623378E 01

 0.29880116E 00=ERMS            0.29880140E 00=RF.ERMS

SIGMAS
 0.50556732E-03  0.36548530E-03  0.19931332E-02

T'S
-0.15716956E 01  0.31106633E 01  0.10347215E 04

 0.58131790E 00=RHO             0.33793050E 00=RHO**2
```

```
MULTIPLE REGRESSION
SUBPROG. NO.=        3
NOS. PER EQ.=       28
NO. OF TERMS=       23
      RUN  19 - 3
NO. OF INPUT LINES=          30
CURR.ERMS= 0.99169324E 02      ADD TERM   16
CURR.ERMS= 0.36722382E 00      ADD TERM    8
CURR.ERMS= 0.30654584E 00      ADD TERM    6

T1= 0.16970000E 01 T2= 0.16970000E 01 TA= 0.00000000E 00 TR= 0.00000010E 00

TERMS
    6    8   16

COEFFICIENTS
-0.79459944E-03  0.11369017E-02  0.20623378E 01

 0.29880140E 00=ERMS             0.29880140E 00=RF.ERMS

SIGMAS
 0.50556732E-03  0.36548530E-03  0.19931332E-02

T'S
-0.15716986E 01  0.31106633E 01  0.10347215E 04

 0.58131790E 00=RHO              0.33793050E 00=RHO**2
```

```
MULTIPLE REGRESSION
SUBPROG. NO.=        3
NOS. PER EQ.=       28
NO. OF TERMS=       23
      RUN  19 - 3
NO. OF INPUT LINES=          30
MEAN= 0.99168667E 02
S. DEV.= 0.36722382E 00
```

```
MULTIPLE REGRESSION
SUBPROG. NO.=        4
NOS. PER EQ.=       28
NO. OF TERMS=       25
      RUN  19 - 4
NO. OF INPUT LINES=           30
CURR.ERMS= 0.99168324E 02       ADD TERM    18
CURR.ERMS= 0.36722382E 00       ADD TERM    30
CURR.ERMS= 0.30664594E 00       ADD TERM     8

T1= 0.16970000E 01 T2= 0.16970000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    8    10    18

COEFFICIENTS
-0.79459944E-03   0.11369017E-02   0.20623378E 01

 0.29880140E 00=ERMS              0.29880140E 00=RE.ERMS

SIGMAS
 0.50556732E-03   0.36548530E-03   0.19931332E-02

T'S
-0.15716986E 01   0.31106533E 01   0.10347215E 04

 0.58131790E 00=RHO               0.33793030E 00=RHO**2
```

```
MULTIPLE REGRESSION
SUBPROG. NO.=        4
NOS. PER EQ.=       28
NO. OF TERMS=       25
      RUN  19 - 4
NO. OF INPUT LINES=           30
MEAN= 0.99168667E 02
S. DEV.= 0.36722382E 00
```

```
MULTIPLE REGRESSION                                            MULTIPLE REGRESSION
SUBPROG. NO.=        1                                         SUBPROG. NO.=        1
NOS. PER EQ.=       28                                         NOS. PER EQ.=       28
NO. OF TERMS=       21                                         NO. OF TERMS=       21
       RUN  20 - 1                                                    RUN  20 - 1
NO. OF INPUT LINES=              46                            NO. OF INPUT LINES=          46
CURR.ERMS= 0.99346035E 02       ADD TERM     4                 MEAN= 0.99345435E 02
CURR.ERMS= 0.34917494E 00       ADD TERM    21                 S. DEV.= 0.34917494E 00
CURR.ERMS= 0.31974770E 00       ADD TERM    13
CURR.ERMS= 0.28206735E 00       ADD TERM     1
CURR.ERMS= 0.24458706E 00       ADD TERM     7
CURR.ERMS= 0.22166663E 00       ADD TERM    14
CURR.ERMS= 0.20529067E 00       ADD TERM     6
CURR.ERMS= 0.18205482E 00       ADD TERM    15
CURR.ERMS= 0.17872287E 00    REMOVE TERM     1
CURR.ERMS= 0.17723183E 00       ADD TERM    17

T1= 0.16710000E 01 T2= 0.16710000E 01 T4= 0.00000000E 00 TR= 0.00000000E 00

TERMS
     4      7      6     13     14     15     17     21

COEFFICIENTS
 0.10007954E 03 -0.17221936E-02  0.77706390E-03  0.77979405E-02 -0.71529835E-02
-0.10777048E-01  0.60232561E-03 -0.18454166E-01

 0.17023284E 00=ERMS              0.17023284E 00=RE.ERMS

SIGMAS
 0.51109488E 00  0.41117612E-03  0.16964816E-03  0.87885295E-03  0.20291819E-02
 0.42481853E-02  0.29138917E-03  0.74696666E-02

T'S
 0.19581401E 03 -0.41884573E 01  0.45804441E 01  0.88728614E 01 -0.35209859E 01
-0.25368591E 01  0.20670630E 01 -0.24715863E 01

 0.87310690E 00=RHO               0.76231566E 00=RHO**2
```

```
MULTIPLE REGRESSION
SUBPROG. NO.=        2
NOS. PER EQ.=       28
NO. OF TERMS=       23
     RUN  20 - 2
NO. OF INPUT LINES=             46
CURR.ERMS= 0.99346035E 02       ADD TERM     4
CURR.ERMS= 0.34917494E 00       ADD TERM    23
CURR.ERMS= 0.31974770E 00       ADD TERM     7
CURR.ERMS= 0.27873774E 00       ADD TERM     6
CURR.ERMS= 0.26256369E 00       ADD TERM    15
CURR.ERMS= 0.25067084E 00       ADD TERM     1
CURR.ERMS= 0.22565179E 00       ADD TERM    10
CURR.ERMS= 0.22005936E 00       ADD TERM    17
CURR.ERMS= 0.21458761E 00    REMOVE TERM     1
CURR.ERMS= 0.21389216E 00    REMOVE TERM    23
CURR.ERMS= 0.21631718E 00       ADD TERM     9
CURR.ERMS= 0.19637893E 00    REMOVE TERM     7
CURR.ERMS= 0.19963251E 00    REMOVE TERM     6
CURR.ERMS= 0.21046237E 00       ADD TERM    14
CURR.ERMS= 0.18032100E 00       ADD TERM    22

T1= 0.16710000E 01 T2= 0.16710000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
     4     9    10    14    15    17    22

COEFFICIENTS
 0.97949534E 02 -0.13696829E-02  0.90684705E-03  0.17615725E-02  0.95283739E-02
-0.64559883E-02  0.30633329E-01

 0.17503332E 00=ERMS             0.17503332E 00=RE.ERMS

SIGMAS
 0.15532336E 00  0.22457310E-03  0.99301344E-04  0.50653992E-03  0.87637214E-03
 0.98364654E-03  0.16161738E-01

T'S
 0.63061690E 03 -0.60990513E 01  0.91322737E 01  0.34776578E 01  0.10872520E 02
-0.65633213E 01  0.18582983E 01

 0.86528696E 00=RHO              0.74872152E 00=RHO**2
```

```
MULTIPLE REGRESSION
SUBPROG. NO.=        2
NOS. PER EQ.=       28
NO. OF TERMS=       23
     RUN  20 - 2
NO. OF INPUT LINES=             46
MEAN= 0.99345435E 02
S. DEV.= 0.34917494E 00
```

```
MULTIPLE REGRESSION                                              MULTIPLE REGRESSION
SUBPROG. NO.=        3                                           SUBPROG. NO.=        3
NOS. PER EQ.=       28                                           NOS. PER EQ.=       28
NO. OF TERMS=       23                                           NO. OF TERMS=       23
       RUN  20 - 3                                                      RUN  20 - 3
NO. OF INPUT LINES=          45                                  NO. OF INPUT LINES=          45
CURR.ERMS= 0.99350609E 02      ADD TERM    4                     MEAN= 0.99350000E 02
CURR.ERMS= 0.35172949E 00      ADD TERM   13                     S. DEV.= 0.35172949E 00
CURR.ERMS= 0.32099788E 00      ADD TERM   23
CURR.ERMS= 0.28515573E 00      ADD TERM    1
CURR.ERMS= 0.24577059E 00      ADD TERM    7
CURR.ERMS= 0.22436537E 00      ADD TERM   14
CURR.ERMS= 0.20682560E 00      ADD TERM    8
CURR.ERMS= 0.17735043E 00   REMOVE TERM    1
CURR.ERMS= 0.17724279E 00      ADD TERM   12

T1= 0.16710000E 01 T2= 0.16710000E 01 TA= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    4     7     8    12    13    14    23

COEFFICIENTS
 0.99778913E 02 -0.24733454E-02  0.84016629E-03 -0.82740751E-03  0.79836487E-02
-0.65738078E-02 -0.15660905E-01

 0.16602970E 00=ERMS              0.16602970E 00=RE.ERMS

SIGMAS
 0.30239946E 00  0.31640926E-03  0.16570075E-03  0.32589892E-03  0.78495447E-03
 0.99191948E-03  0.73413322E-02

T'S
 0.32995732E 03 -0.90811171E 01  0.50701072E 01 -0.25388470E 01  0.10170843E 02
-0.66273603E 01 -0.21332511E 01

 0.88157818E 00=RHO               0.77716009E 00=RHO**2
```

```
MULTIPLE REGRESSION                                                MULTIPLE REGRESSION
SUBPROG. NO.=        4                                             SUBPROG. NO.=        4
NOS. PER EQ.=       28                                             NOS. PER EQ.=       28
NO. OF TERMS=       25                                             NO. OF TERMS=       25
       RUN  20 - 4                                                        RUN  20 - 4
NO. OF INPUT LINES=           45                                   NO. OF INPUT LINES=           45
CURR.ERMS= 0.99350000E 02      ADD TERM     4                      MEAN= 0.99350000E 02
CURR.ERMS= 0.35172949E 00      ADD TERM    15                      S. DEV.= 0.35172949E 00
CURR.ERMS= 0.32009788E 00      ADD TERM    25
CURR.ERMS= 0.28515573E 00      ADD TERM     1
CURR.ERMS= 0.24577059E 00      ADD TERM     9
CURR.ERMS= 0.22438537E 00      ADD TERM    16
CURR.ERMS= 0.20682560E 00      ADD TERM    10
CURR.ERMS= 0.17735043E 00   REMOVE TERM     1
CURR.ERMS= 0.17724279E 00      ADD TERM    14

T1= 0.16710000E 01 T2= 0.16710000E 01 T4= 0.00000000E 00 TR= 0.00000000E 00

TERMS
    4     9    10    14    15    16    25

COEFFICIENTS
 0.99778913E 02 -0.28733464E-02  0.84016629E-03 -0.82740751E-03  0.79836487E-02
-0.65738078E-02 -0.15660905E-01

 0.16602970E 00=ERMS             0.16602970E 00=RF.ERMS

SIGMAS
 0.30239946E 00  0.31640926E-03  0.16570975E-03  0.32589892E-03  0.78495447E-03
 0.99191948E-03  0.73413322E-02

T'S
 0.32995732E 03 -0.90811071E 01  0.50701079E 01 -0.25388470E 01  0.10170643E 02
-0.66273603E 01 -0.21332511E 01

 0.88157818E 00=RHO              0.77718009E 00=RHO**2
```

TABLE 1C

HELHAT I Analysis of Variance - All Target Sightings

ORDER	1	2	3	4	5	6	sum	SUM
Front	20	17	20	18	16	21	112	
Rear	22	19	24	19	15	22	121	
sum	42	36	44	37	31	43		233
Rear	14	23	13	20	21	21	112	
Front	20	25	20	21	24	21	131	
sum	34	48	33	41	45	42		243
Left	19	18	24	18	23	21*	123	
Front	20	21	17	21	19	21*	119	
sum	39	39	41	39	42	42		242
Front	14	13	15	25	22	22	111	
Left	16	20	22	28	28	24	138	
sum	30	33	37	53	50	46		249
Rear	14	19	24**	18	20	22	117	
Left	19	25	27	21	26	22	140	
sum	33	44	51	39	46	44		257
Left	20	21	17	21	23	21*	123	
Rear	19	21	24	18	22	20*	124	
sum	39	42	41	39	45	41		247
TOTALS	217	242	247	248	259	258		1471

Correction Term = 30053.347
Sum of Squares Total - 30839 - C.T. = 785.653
Sum of Squares Rows = 360961/12 - C.T. = 26.736
Sum of Squares Columns = 361811/12 - C.T. = 97.569
Sum of Squares Error = 30839 - 61313/2 = 182.500
Interaction = 785.653 = (26.736 + 97.569 + 182.5) = 478.848

* Missing data technique applied to fill cell
** Moved data

TABLE 2C

HELHAT I Analysis of Variance - All Targets $\pm 080^{o}$ of Heading and Range > 100 Meters

ORDER	1	2	3	4	5	6	sum	SUM
Front	13	16	17	15	14	17	92	
Rear	20	16	20	18	14	19	107	
sum	33	32	37	33	28	36		199
Rear	13	17	12	15	16	16	89	
Front	19	24	15	20	22	16	116	
sum	32	41	27	35	38	32		205
Left	17	18	18	18	15	17*	103	
Front	19	14	15	14	18	19*	99	
sum	36	32	33	32	33	36		202
Front	12	11	14	19	15	17	88	
Left	15	18	19	24	27	17	120	
sum	27	29	33	43	42	34		208
Rear	14	14	20**	12	18	13	91	
Left	18	21	26	18	25	17	125	
sum	32	35	46	30	43	30		216
Left	17	20	15	20	17	17*	106	
Rear	19	18	21	16	15	18*	107	
sum	36	38	36	36	32	35		213
TOTALS	196	207	212	209	216	203		1243

Correction Term = 21459.01
Sum of Squares Total = 22105 - C.T. = 645.99
Sum of Squares Rows = 21476.58 - C.T. = 17.57
Sum of Squares Columns = 21479.58 - C.T. = 20.57
Sum of Squares Error = 22105 - 43619/2 = 295.50
Interaction = 645.99 - (17.57 + 20.57 + 295.50) = 312.35

*Missing data technique applied to fill cell.
**Moved data